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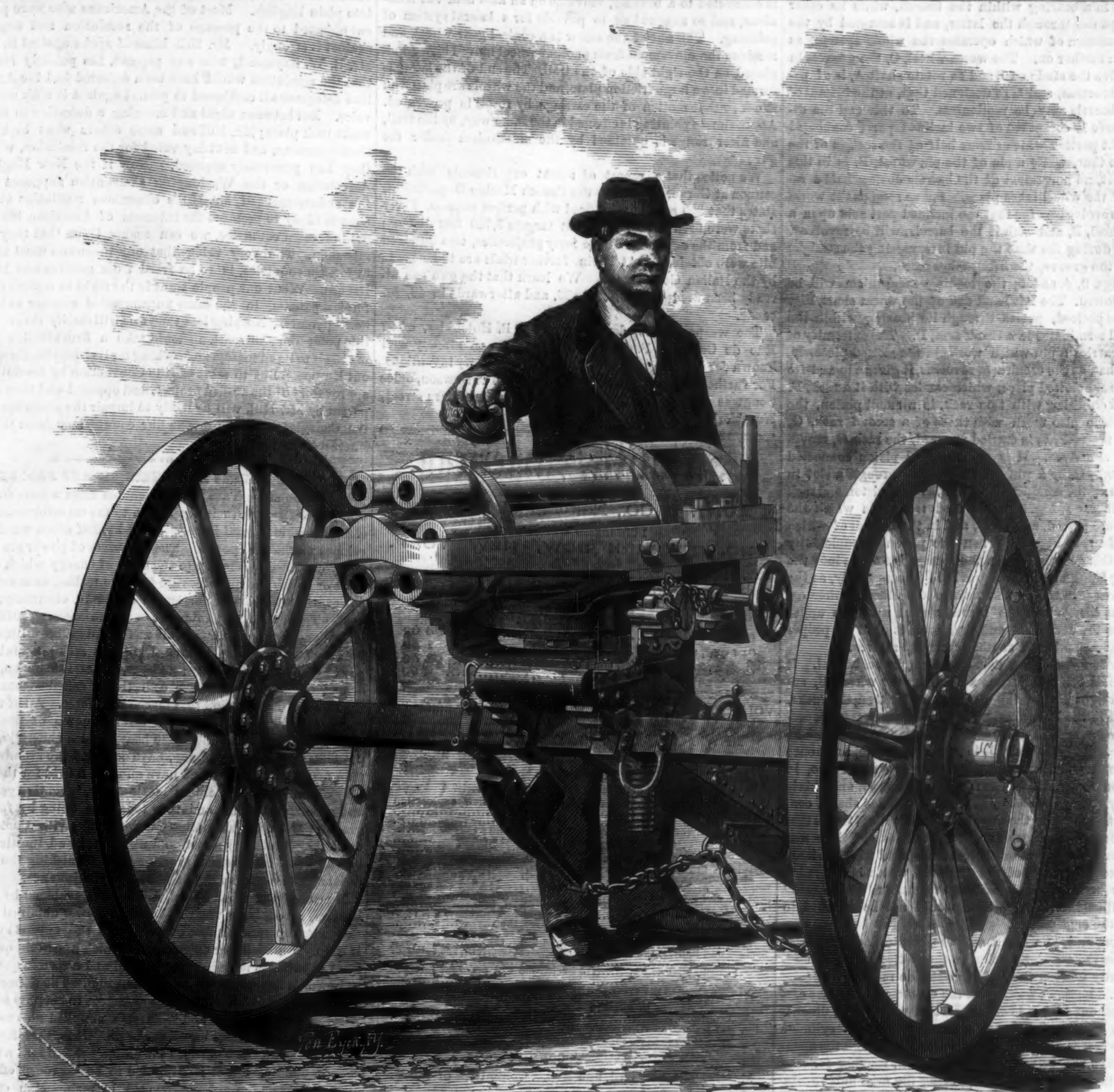


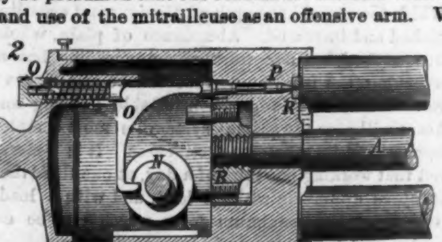
THE HOTCHKISS MITRAILLEUSE.

THE HOTCHKISS CANNON REVOLVER.

It may be presumed that our readers are familiar with the nature and use of the mitrailleuse as an offensive arm. Various forms of the weapon have already been represented in these columns, and the respective merits of the Gatling, the Taylor, the Sigl, and other kindred guns have been fully described. While all of these deadly arms will doubtless bear their full share in the determination of future wars, few, we believe, will prove more formidable than the weapon illustrated in the engravings hereto annexed. It is not a battery of musket barrels, but, as its name indicates, a bundle of rifled cannons which throw explosive shells, or other projectiles, weighing 23·5 ounces, and this at the rate, as experiment has shown, of sixty shots in forty-eight seconds. No demonstration is needed to point out the fearful execution of which such an arm is capable.

The cannon, in exterior form, resembles the Gatling gun, but its mechanism, as will be seen as we progress, is essentially different. The working portions may be divided into two distinct parts: First, the barrels with their shaft and frame; and, second, the breech with the firing and charging apparatus. Fig. 1 affords a general perspective view of the gun, from which it will be seen that the barrels are six in number. These are made of cast steel, and are mounted between two disks which are rigidly secured to a central shaft (A, in the sectional view, Fig. 2), which goes through the front of the breech. To the latter is attached the frame, which extends alongside the barrels and supports the shaft, A, at its outer end. It is clear that, if the central shaft be suitably rotated, it will carry the barrels around with it. Attached to the interior part of the frame is a turning table, which connects the cannon to a saddle with trunnions fixed on the carriage, so that, without displacing the latter, a car-

Fig. 2.



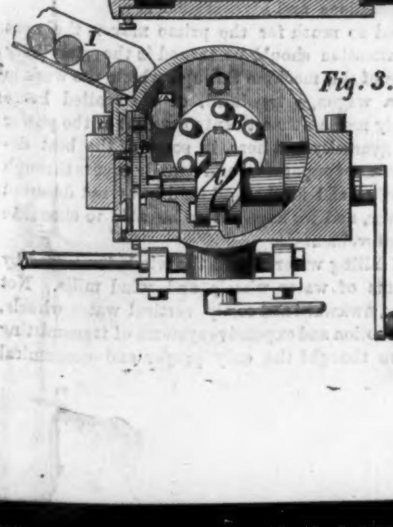


Fig. 3.

Fig 4

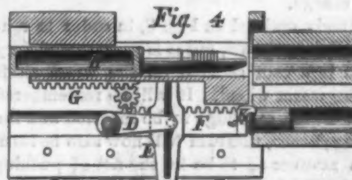


Fig 5

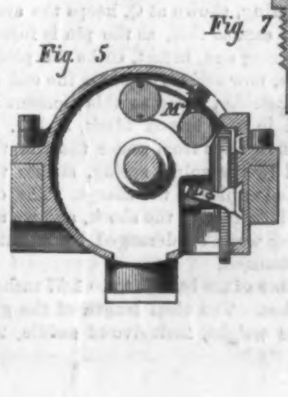


Fig 6

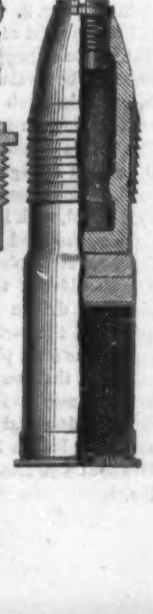


Fig 7

tain amount of lateral motion, as well as of elevation, may be given to the gun. The breech is composed of a block, containing the mechanism and closed at the rear end by a cover, shown in Fig. 2, which is fixed by two set screws, so that it may be easily removed and ready access thus afforded to the interior portions.

Beginning our explanation with the revolving mechanism, B, in Fig. 3, is a pin wheel keyed inside the breech to the end of the shaft, A, and carrying six studs upon its rear face, arranged parallel to each other. C is a worm wheel which is mounted on a shaft at right angles to shaft A, that is, transverse the breech. The left hand end of the worm shaft turns in a bearing within the breech, while its other extremity passes through the latter, and is actuated by the crank, the motion of which operates the whole system, as will be seen further on. The worm wheel, C, the grooves in which receive the studs on B and so rotate shaft A, is of peculiar construction, and is so designed that, at the instant of firing, the barrels may be motionless. To this end the directing groove is composed of two inclined parts connected by a straight portion which covers half of the section of the cylinder, so that, while a pin of the pin wheel, B, is in this straight part, no movement of the barrels during half a revolution of the wheel takes place. But as soon as the worm wheel has revolved so far that the inclined part acts upon a pin, the wheel, B, and with it the barrels, will be revolved. Of course, during the time the pin is traversing the straight portion of the groove, the firing takes place.

From Figs. 3, 4, and 5, the loading mechanism will be readily followed. The left hand end of the worm shaft, Fig. 3, it will be noticed, passes through its bearing within the breech, and terminates in a crank arm, D. The extremity of the latter carries a pin which works in the slotted piece, E, Fig. 4, so that, as the crank arm revolves, it gives a to-and-fro motion to said slotted piece, which carries with it a rack, F. Above, and engaging with this rack, is a small pinion, the teeth of which also mesh with those of a second rack, G, so that, as the rack, F, is carried forward, the rack, G, moves back, and *vice versâ*. H is a cylindrical piston connected with the rack, G, by a pin which travels through a slot in the bottom of the conducting trough, so that piston and rack work together. I, Fig. 3 is the feed trough in which the cartridges are placed, as shown, and in the bottom of which is a little door, J, Fig. 5. When the piston is sufficiently retracted, this door falls open and a cartridge drops into the conducting trough by its own gravity. Subsequently, as the piston moves forward, in the manner described further on, to drive the charge into the barrel, a stud upon its upper side pushes the door shut, and thus holds it until the proper time for the reception of another cartridge arrives.

As shown in Fig. 4, the crank arm, D, is horizontal. It arrives at this position just as a pin upon the wheel, B, enters the straight part of the worm; and of course the racks, as depicted in the last mentioned figure, are drawn respectively forward and backward to their fullest extent. As above noted, the little door, J, is now free to open, and hence a cartridge drops in before the piston. The racks also, in the position shown, remain at rest for a moment, and this is effected by giving the slot in E, Fig. 4, a circular shape, concentric to the shaft of the crank. The object of this is that at this moment, the barrels arriving at the end of their motion, a spent cartridge in one becomes engaged with the large double hook, K, Fig. 4, of the extractor, which is secured to the lower rack, F, and hence, if the motion of the racks were not thus interrupted, time would not be afforded to complete the engagement.

The crank arm, D, we will suppose, continuing its revolution, passes the circular portion of the slotted piece, E, and, consequently moving the latter, starts the racks in opposite directions. Rack, F, pulling on the extractor, drags the cartridge shell out of the lower barrel and to the rear, until it meets an ejector, L, Fig. 5, against which the cylinder strikes, is detached and falls to the ground through the opening shown in the breech block. Rack G, moving forward and carrying with it the piston, during the next half revolution of the worm wheel introduces the cartridge into its barrel; the latter, it will be remembered, necessarily stands still. The cartridge is, however, not driven in all the way, but its head is in view of an inclined plane, M, Fig. 5, which is cut into the metal of the breech, on which it slides when carried around by the movement of the barrels. This completes the introduction of the charge.

The firing apparatus is omitted in Fig. 3, in order to render other parts more clearly shown, but it is represented very plainly in Fig. 2. N is a cam secured on the worm shaft and to the right of the worm wheel. It will be remembered that we have supposed the cartridge to be inserted and the barrels to be revolving; hence, this cam will now also be turning, and in such a manner as to be in the act of pushing back the long arm, O, which connects with the firing pin, P. The action of the spiral spring, shown at Q, keeps the arm, O, pressed up against the cam so that, as the pin is forced back, it compresses the spring and, in fact, cocks the piece. The barrel, with its charge, now arrives opposite the end of the pin, the head of the cartridge being at this moment in face of a steel plate fixed in the breech block, R, Fig. 2. The shoulder of the cam now slips from under the arm, the pin, P, is driven forward by the spiral spring, strikes the primer of the cartridge, and explodes the charge. The object of the steel plate, R, is to receive the shock, and we are informed that, on becoming worn or deranged by repeated firing, it may be readily changed.

We understand the caliber of the barrels to be 1·57 inches, and their length 38·1 inches. The total length of the gun is about 4·89 feet, and its weight, inclusive of saddle, 968 lbs.

Figs. 6 and 7 represent, respectively, the form of fixed ammunition used and the percussion fuse. The total weight of the charged cartridge and shell is 26·3 ounces, and of the charge alone, 2·8 ounces, and the length is 7·2 inches, The fuse, Fig. 7, consists of a case which, in its under part. contains a lead plunger, S, with a brass envelope. The plunger holds the fulminate, and has a little powder chamber at T. It is fastened by a safety plug of lead in the under hole of the fuse, and it is closed by a plug which has the point against which the plunger drops at a sudden stop of of the projectile.

The elevating screw of the gun is so made that the head is connected to a bearing, movable on an axis near the trunnions, and so annexed as to provide for a lateral system of pointing. The nut of the screw is a conical gear wheel, and receives the movement from another wheel moved by a crank placed on the right side of the trail. The end of the latter is formed into a large friction plate, and the wheels are placed on shoes so that motion of the carriage by recoil is prevented. Approximate pointing is effected in the same way, by the trail, and nicer range is obtained by the mechanism under the gun.

We notice that a report of recent experiments with the cannon at Garve, France, by the French Marine Department, states that 500 rounds were fired with perfect success. Forty shots were fired in 30 seconds at targets 5,760 feet distant; and from the explosion of the forty projectiles, two hundred hits were obtained. At Turin, further trials are to be made by the Italian Government. We learn that the gun has already been fired sixty shots in 55, and afterwards in 48, seconds.

The weapon is the device of Mr. B. B. Hotchkiss, of 27 Rue de Choiseul, Paris, France, a gentleman already well known for his rifle projectiles and other military inventions. For further information address, care of C. C. Dawson, office Congress and Empire Spring Company, 94 Chambers street, New York city.

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Contents:

(Illustrated articles are marked with an asterisk.)

NEW PATENT CONVENTIONS.

Messrs. Thacher, Hill, and Blake, Committee of the Vienna International Patent Congress, have, in accordance with their official authority, issued a call, addressed to all who are interested in the effort to secure better patent protection for Americans in foreign countries, for a Convention, to be held in the city of Washington. The Committee say that: "Our friends abroad greatly need the information and aid which we can readily furnish, *for we are the foremost nation in the world in the liberality and success of our patent system.*"

This characteristic assemblage of American Patent Saints is called for January 15, 1874, for the purpose of discussing this topic, so says the call, and if thought desirable, of organizing a United States Patent Association. We hope the attendance will be full, the proceedings harmonious, and the results practical. This Convention is to have the aid of another Convention, recently organized at Boston, called the New England Association of Inventors and Patent Owners. The objects of this association, so far as we can gather from the reports of the proceedings, are to render mutual aid and benefit to the members in the management of their patents, to secure the extension of their several patent monopolies, compel the payment of fair prices for patents by railway companies, and in other ways "to promote the general prosperity of the country."

Among the prominent members of this new association is Mr. Hamilton A. Hill, who also figures as one of the Committee of the Vienna Congress, and as one of the callers of the Washington Convention. He offered a couple of resolutions, one of which was that the association should be represented at Washington by delegates; the other: "That this Convention heartily endorses the action of the Congress lately held at Vienna on the subject of patents." Both resolutions were adopted. We congratulate Mr. Hill in having thus succeeded in getting himself endorsed by the New England Association. Possibly he may have equally good luck before the Washington Convention.

It is well known to our readers that the resolutions adopted at the Vienna Patent Congress contained hardly a single point or suggestion for change in the existing laws of the leading continental governments, except this, namely: That the laws ought to provide that the inventor shall be compelled to sell his invention and rights under the patent, at such prices as government officers shall dictate. This is not the exact wording of the resolution, which was framed in the German idiom, but we give its real meaning, translated into plain English. Most of the Americans who were present objected to the passage of the resolution and argued against it strongly. Mr. Hill himself spoke against it, and Mr. R. W. Raymond, who was present, has publicly stated that the resolution would have been defeated had the American delegates all continued to protest against it with united voice. But between night and morning a defection in their ranks took place; Mr. Hill and some others went back on their comrades, and next day voted for the resolution, which they had previously opposed. Now if the New England Association or the Washington Convention supposes that the endorsement of Mr. Hill's obnoxious resolution at Vienna is likely to promote the interests of American inventors in foreign countries, we can assure them that they are mistaken. The very thing that our inventors most need, in foreign countries, is to be freed from government interference. What our people want is the right to control their foreign patents, in the same untrammeled manner as their home patents. Nothing less than this will satisfy them. On this point the Convention should take a firm stand, pledging itself to its advocacy, and seeking for its adoption throughout Europe. But to start off the Convention by resolutions approvatory of the absurd project, first opposed and then supported by Mr. Hill, will be likely to impair the usefulness of the Convention, and prevent our countrymen from taking interest in its proceedings.

THE PRIME MOVERS AND THEIR RECENT PROGRESS.

The prime movers are those machines from which we obtain power through their adaptation to the transformation of some available natural force into that kind of effort which develops mechanical power. These sources of power are generally classified, according to the form of energy which they yield or which the machines are fitted to utilize, as muscular power, the weight and movement of fluids, electricity, and heat. Thus, men and animals are prime movers, utilizing muscular power; water wheels and wind mills utilize the fluids water and air; electrical engines make useful the power of the voltaic battery; and gas, air, and steam engines —heat engines, as they are collectively called—transform the force of heat motion into mechanical force. All of these prime movers have received a certain degree of development; and some of them, as the heat engines generally, and particularly the steam engine, have occupied the attention of man for many centuries and have afforded a field for the display of his highest scientific attainments, inventive genius, and mechanical skill; and they today are doing by far the greater part of the unintellectual work of civilization. Indeed, they indirectly assist, to a wonderful and inestimable extent, even intellectual progress, by furnishing the material aids essential to its existence and continuance.

Muscular power has its origin in heat developed by combustion, probably, as truly as does the power obtained from the generally termed heat engines; and the animal system is simply a machine or apparatus in which a certain quantity of oxydizable material is consumed and a certain quantity of power is developed by its consumption. The animal system is compelled to furnish heat sufficient to keep its several parts in working order, and to furnish supplies also to that strange and wonderful organ the brain. It is, therefore, impossible to state how efficient the animal system is as a prime mover, simply, but it is supposed to be far more efficient than any machine yet constructed by man. Man can do little to improve the efficiency of the animal mechanism, but he can do something. Whether the organism to be used as a prime mover be that of a man or of a beast, the proper treatment by which to obtain maximum efficiency is that by which the natural strength of *physique* and constitution is cherished and increased. Abundance of plain, wholesome, nutritious food, regular work, never exceeding but always approaching the maximum that can be attained without more than moderate fatigue, comfortable housing and general care will give the animal system its most complete development and its greatest effectiveness. It is generally believed that working one third of a day, at one third the maximum speed attainable without load, and with a load equal to one third the maximum force which can be exerted, gives the best conditions and highest efficiency.

Having effected so much for the prime mover, the next point to which attention should be turned is the simplicity and effectiveness of the machine through which the work is done, whether a wagon, a treadmill, or a so-called horse power. Probably not less than twenty per cent of the power of the animal is generally lost here, in some of the best designs of these forms of apparatus, and usually occurs through friction. Invention and mechanical skill have not deserted this field, however, and we hope yet to be able to chronicle some useful improvements.

The power of falling water and of the winds is utilized by the various forms of water wheels and wind mills. Not many years ago, awkward and costly vertical water wheels, with their slow motion and expensive systems of transmitting machinery, were thought the only proper and economical

forms of water engines. They still remain, as a class, unexcelled in economical efficiency, but they have found rivals in the smaller, quickly working, and far cheaper and more satisfactory turbines, and have been almost completely driven from the field.

The power of prime movers is measured by horse power. Watt found that the strongest London draft horses were capable of doing work equivalent to raising 33,000 pounds one foot high per minute, and he took this as the unit of power for the steam engine. The horse is not usually capable of doing so great a quantity of work. Rankine gave 26,000 foot pounds as the figure for a mean of several experiments, and it is probable that 25,000 foot pounds is a fair minute's average work for a good animal. It would require five or six men to do the work of a strong horse. Watt's estimate has become, by general consent among engineers, the standard of power measurement for all purposes.

The weight of water flowing per minute, over a weir or dam, being multiplied by the hight of available fall, gives a product in foot pounds per minute, which, divided by 33,000, gives the horse power of the stream. Of this power, a certain proportion is always lost through the inefficiency of the machinery of the prime mover which is intended to utilize it. The best overshot and high breast water wheels yield as a maximum but little over seventy-five horse power where the available power of the fall is one hundred. The best turbines have about the same efficiency as the vertical wheels when precisely proportioned to their work. In all wheels, a loss greater than twenty per cent is met with when running on "part gate." There is, therefore, room for improvement in water wheels to the extent of twenty per cent or more. These losses are to be lessened by more skillfully proportioning the wheels, and especially by some arrangement which will allow them to work efficiently with varying gate. The prime defects at present exist in the method of adjusting the wheel to do its work with different loads. Hardly less important is the problem of effectively connecting the governor to the wheel gate. Much has been done in these directions, but much remains to be done. Some wheels will do nearly as good work at part gate as at full gate, but usually this efficiency is attained by the sacrifice of simplicity and of maximum economy. A wheel which will invariably yield seventy-five per cent of the power of the fall under which it works, and do this under all loads, is yet to be brought into the market. The high tide of progress has culminated in the successful competition of the small, lively, and cheap turbine with the older forms of wheel, which are now nearly driven out of use. By far the most important work in cheapening the construction of turbine wheels and in making them efficient has been done by American mechanics.

The windmill is largely used on our western prairies and to a considerable extent elsewhere. The improvements lately made on this motor have been principally in the structure and arrangement of the vanes, making them self-regulating, and in so constructing the apparatus that it shall keep itself pointed toward the wind. Abroad, nothing seems to have been done, but our own inventors have accomplished some good work in this field, the extent and importance of which are not generally appreciated. We have but little information as to the efficiency of windmills. They are probably less effective than water wheels, and their improvement remains a promising task for ingenious mechanics.

The force derivable from electricity has long engaged the attention of most active minds, but we cannot yet chronicle any really well settled and important advance towards its utilization. Indeed we can hardly anticipate its employment to any considerable extent until new methods of generating the force itself are discovered. The available power to be obtained by the consumption of zinc, which is the metal consumed in the voltaic battery, is estimated, by various authorities, at from one half to one sixth that derivable from an equal weight of coal, and the great difference in price between zinc and coal, pound for pound, makes the difference in cost of power vastly in favor of coal. A quarter of a century or more ago, many attempts were made, some upon a large scale, to utilize electric force in the production of mechanical power, but with no success. Our countryman Page, who in 1850 obtained power from a small engine at a cost, as he stated, of about a cent per horse power per hour was the most successful; but even he finally failed, and no one has since been more successful. Attempts are still made and are almost daily brought to our notice; and occasionally a charlatan or a self-deceiver deludes credulous listeners, by the claim of wonderful results. We hope that we may find such a claim well founded, in some time to come, but we fear that it will be very far in the future, unless some fortunate man shall discover a method of evolving electricity, in place of heat, from the oxidation of coal. That done, the problem would be far less difficult of solution, and we should look hopefully for a splendid development of this field, which would have then become most promising.

PROGRESS OF THE CENTENNIAL.

With the object of enlisting the coöperation and interest of the people of New York in the coming Centennial, a delegation from the Board of Finance of that enterprise recently met with the members of the Chamber of Commerce of this city. The Philadelphia committee deprecated any feeling of sectional rivalry and urged, with much earnestness, the view that the exhibition was a national affair, and that it deserved the hearty support of the whole country. The New York merchants replied in similar strain, cordial expressions of coöperation were exchanged, and a committee of seven was appointed to solicit aid from the people of the State. As regards progress, we find it stated that the Board of Finance has confined its operations principally to Pennsylvania, in which State $1,500,000 have been subscribed by citizens and corporations. California has promised her full quota, and efforts have been begun in order to raise funds in Delaware and Maryland. The work of construction is to be rapidly pushed during the coming spring. A temporary building covering from 35 to 40 acres is to be erected, and the permanent structure will be commenced at the same time. The former edifice is to cost from two to three million dollars, and the latter, half a million. The machinery, horticultural, and agricultural halls, are each to cost $500,000, and it is believed that the preparation of the ground, sewage, etc., will use up the remainder of the $10,000,000 required.

The prospects of foreign participation are very encouraging. At the assembling of the German Parliament, Prince Bismarck recommended the acceptance of the invitations and also urged the appointment of a plenipotentiary to reside in Philadelphia during the Exposition, and of a commissioner for each State of the empire. Belgium has promptly signified her intention to contribute, and the republic of Ecuador has made an appropriation for the purpose, and already has a resident commissioner in Philadelphia. Official notifications of intended participation have also been received, by the Government, from Mexico and Hayti. Professor W. P. Blake, special agent for the centennial at the late Vienna exhibition, says in his report that he has received assurances of freindly interest from the Emperor of Austria and other high officials. He has already obtained contributions for a permanent museum, consisting of Swedish iron ores, and a valuable collection of terra cotta work, samples of ozokerit, etc. China and Japan, it is considered, will be well represented, and the Turkish merchants are to erect a grand bazar, coffee houses, bath, and, in some convenient portion of the grounds, a complete Turkish village.

We hope capitalists, merchants, manufacturers, inventors, and every other class of our citizens will take an active interest in promoting the success of this great patriotic Centennial exhibition.

EXPERT ENGINEERING.

We are constantly in receipt of inquiries as to what are the requisite qualifications for an engineer. This word as it is frequently employed is somewhat of a misnomer. An engineer, in the broadest signification of the term, is an expert in engineering, one who is practically acquainted with the construction and management of heat engines: who is thoroughly versed in the physical laws which relate to the formation and use of steam and other motive powers: who can design machinery, and adapt it to the various purposes for which it is intended. But in common parlance, every one who has control of an engine or boiler is known as an engineer. From this fact, much misunderstanding frequently results. The proprietor of a factory, for instance, sees no difference between the person who takes care of his engine and the consulting engineer who offers his services in expert cases, except, perhaps, that he looks upon the former as a practical man, and therefore one who is always certain to think and act correctly, while he considers the latter a theoretical engineer, whose opinions are entirely too visionary to be of any value. We think we have not overstated the comparison that is usually made between what are known as practical and theoretical men. But it may be worth while to look into the matter a little, and see whether the popular estimate is a just one. The purely practical man, as we understand it, is one who knows nothing but what he has acquired by actual practice; and things that he has not seen and handled, as it were, he will not believe. Now the engineer who is understood to be theoretical has ordinarily enjoyed quite as much practice as the other, but he has labored more understandingly, investigating the principles of the work in which he is engaged, and endeavoring by the application of these principles to effect changes and improvements. There is little doubt that the intellect of man is his most valuable possession, and that the cultivation of this faculty will give him greater rewards than he can hope to acquire by manual labor. It is true, however, that his theories, if unsupported by facts, are little better than idle dreams, so far as their value to the community is concerned. James Watt, in making his splendid inventions relating to the steam engine, carried theory and practice hand in hand. Starting with a rude model, he determined practically what it would do, and reasoned out what it ought to do if it were a perfect machine, and then turned his attention to making it fulfil the conditions called for by his theoretical investigation. Surely the result justified all his experiments and hypothesis.

Professor Rankine, lately deceased, and perhaps the most remarkable engineer that the world has ever known, united, in a most happy degree, the use of theory and practice. The result of his labors, cut short by an early death, can hardly be appreciated as yet; but in giving to the world the first accurate theory of the action of heat engines, he has enabled future experimenters and inventors to work with a clear knowledge of the nature of the problems which they wish to solve.

We hope we have succeeded in demonstrating to our readers that theory and practice are not naturally antagonistic, and that the professions of engineer and engine driver, both honorable ones, are quite distinct, the former comprising all that is contained in the latter, and embracing additional details.

If we have induced the owner of steam power to alter his opinion of the expert engineer, perhaps we may persuade him that he can occasionally employ the services of this expert with profit to himself. If every time that steam was raised in his boiler a large quantity continually escaped through some opening that was plainly visible, he would not hesitate a moment to have the leak repaired. We are able to state, from our own knowledge, that this state of affairs practically exists in many places where steam power is used, with the important exception that the leak is not visible to the ordinary observer. To find this leak is the task of the engineer, and surely the owner will be amply repaid if he succeeds, for a trifling amount, in having repairs made which will save him thousands of dollars yearly. The Royal Agricultural Society of England, at their yearly exhibitions, are accustomed to test the engines that are entered for competition. An investigation of the results obtained from year to year shows a most extraordinary improvement in the engines, as regards economy and workmanship, and there is little doubt that the effect of these tests has been most beneficial to the users of steam power. In this country, comparatively few reports of tests have been made public, and we are lamentably ignorant in regard to the performance of machinery made even by our best manufacturers. This is a matter in which every user of steam power is directly interested, and we hazard little in saying that all owners of steam engines would find it profitable to have tests made by reliable experts at least once a year. From examinations that we are continually making in the city, and by letters that we frequently receive from abroad, we are convinced that there are many steam engines which stand in need of professional assistance. The steam engine indicator has been likened to the stethoscope of the physician, but it should be remembered that either, in unskillful hands, will be productive of but little benefit. There are many cases, besides, in which other tests than those made with the indicator are called for; but so far as our experience goes, the skillful engineer is generally able to find the trouble and devise a remedy, when his services are called into requisition.. Those who are accustomed to read that portion of our paper devoted to questions and answers have doubtless noticed that we receive many letters in relation to the power that can be transmitted by a belt. It is a very common practice in letting power to calculate the amount furnished from the width and speed of the driving belt. But this is a very uncertain estimate, as in some cases the belt will transmit more and in others less than the rated power. If a few tests were made of the bulk of a pound of sugar, and the article were ever afterwards sold by guess work, the bulk furnished being based, by the seller's eye, on the amount previously determined by experiment, we venture to assert that neither dealer nor purchaser would be satisfied. And yet this is just the course pursued in circumstances where the amount of power can be as accurately determined as the quantity of sugar to be furnished for a pound. Cases have come to our knowledge in which the amount of power actually furnished varied as much as two hundred per cent from that given by calculation.

Some years ago, we heard of a bridge contract being let, in which it was stipulated that none of the material was to be strained, when subjected to the maximum load, to more than one sixth of its ultimate strength. When the structure was completed, a simple calculation showed that the maximum load brought a strain equal to one third of the ultimate resistance. The bridge commissioners performed a simple sum in arithmetic for the benefit of the constructor, worked somewhat in this manner: If a ton of iron costs D dollars, and it would require W pounds to give a factor of safety of six, and the price of the bridge is to be P dollars, if constructed according to specifications, what should its price be if it contains only half as much iron, so as to give a factor of three? Payment for the bridge was made according to the solution of this question, to the intense disgust of the contractor. A similar sum might be worked out with considerable profit to the purchasers of many steam engines and boilers, who find that their machines fall far short of the power at which they were rated by their makers.

This article has already extended beyond our proposed limits, and we have merely touched upon the benefits that users of steam power can obtain from reliable expert assistance.

TO OUR SUBSCRIBERS.

We take great care to send our paper with regularity to every one of our subscribers. All of our employees in the mailing department are under injunctions to write each address plainly and to fold each paper nicely. If any of our subscribers fail to receive their papers regularly or observe any faults in the folding or addressing, we shall feel obliged if they will notify us, by postal card or letter, in order that we may promptly correct the matter. Do not hesitate to complain, and repeat the complaint, if necessary, until correction is made. When the address is not legibly written, we should be glad to receive back the portion of wrapper containing the faulty writing.

The Value of the Scientific American.

One of our esteemed subscribers, in lately writing to us about the renewal of his paper for the next year, says that he has taken the SCIENTIFIC AMERICAN regularly for the past twenty-five years, and has the volumes for that long period, all bound. He was recently offered a farm of one hundred and sixty acres of land, free and clear, in exchange for these volumes, but declined the trade. He has derived great benefit from the volumes, and holds them to be of more value to him than many hundred acres of farming land.

One Hundred and Fifty Thousand.

The demand for our special number of the SCIENTIFIC AMERICAN has induced the publication of a second edition. Advertisers who were promised the circulation of 60,000 have derived the benefit of 150,000 without extra charge.

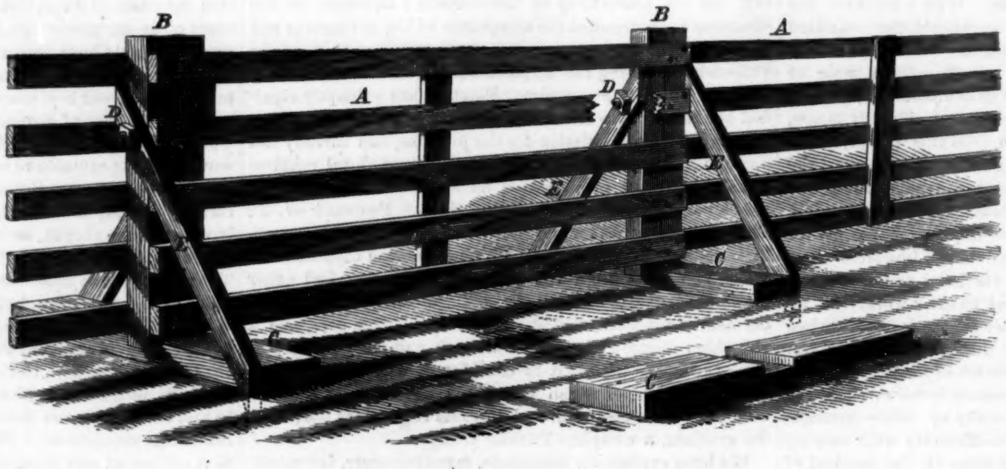
IMPROVED PORTABLE FENCE.

The invention herewith illustrated is an improvement in portable fences for farm or other purposes, which, it is claimed, is durable, substantial, and requires very little labor to construct or set up in place.

The panels, composed of rails, A, and posts, B, are fastened together by nails or in any suitable manner. The posts may be placed both on one side, or one on each side of every panel. C are the bed pieces, one of which is shown separately in the foreground, in the upper side of each of which a gain is cut to receive the bottom ends of the posts. The latter stand up in the gain in contact with each other, as, indicated in the engraving, and are fastened together by a bolt and nut, D, the former of which is made of suitable length, so as to allow of proper separation of the posts at top or bottom, in case the fence be extended over undulating ground. The same bolt serves to secure the upper ends of the braces, E, which continue below the bed piece and enter the earth, as shown by the dotted lines. By removing the bolt, the panels, as well as the braces and bed pieces, are left free and may be readily removed. If desired, the braces may be fastened to the bed pieces in any suitable manner.

This device appears to be a convenient and economical arrangement, which can doubtless be employed in a variety of places by farmers and others.

Patented through the Scientific American Patent Agency, by Samuel S. Porter, of Broad Ford, Fayette county, Pa., who may be addressed for further information.



PORTER'S IMPROVED PORTABLE FENCE.

Hawley's Kiln.

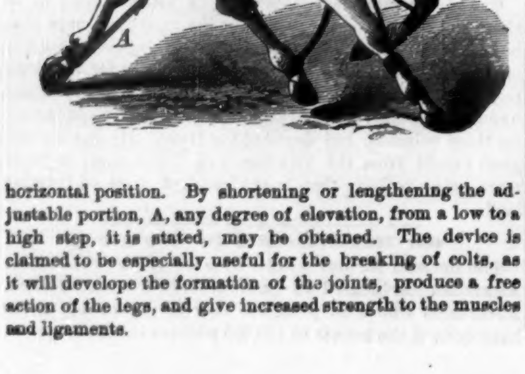
We learn that some very important features have been added to the Hawley kiln (for burning brick, tile, pottery, etc.) since our illustrated descriptions published April 27, 1872; one of which consists in utilizing the heat to a room ahead, while burning, thus drying off the compartment in advance of the already burning chamber. This effects a saving of the surplus heat, which would otherwise escape up the chimney during the process of burning, and after the contents of the burning chamber have been thoroughly dried off and heated through.

Again, in utilizing the heat contained in the incandescent mass remaining in the already burned chamber, the cooling off process is carried on from above downwards, in the same direction pursued during the process of burning (instead of by reversing the current of air as previously described); thus exposing the contents of the oven alike throughout, both in burning and cooling.

IMPROVED TROTTING GEAR.

Mr. Henry Schmalhausen, of Bridgeport, Ill., has recently patented an elastic trotting gear for horses, the object of which is to enable the animal to trot faster, and raise his feet higher, and also to prevent him from balking, kicking, backing, or rearing.

The apparatus consists of an elastic strap so constructed as to be adjustable in length, and which is passed and plays easily through the hame ring which guides the lines. The ends of the strap are attached to bolstered bands, which may be readily buckled, one to the fore and the other to the corresponding hind leg. The gear may be so applied that the knee joint will be raised to a level with the shoulder joint, which throws the fore leg on the forward step into nearly a horizontal position. By shortening or lengthening the adjustable portion, A, any degree of elevation, from a low to a high step, it is stated, may be obtained. The device is claimed to be especially useful for the breaking of colts, as it will develope the formation of the joints, produce a free action of the legs, and give increased strength to the muscles and ligaments.



Focal Differences in the Eyes.

A writer in *Science Gossip* speaks of the difficulty which some persons experience in the use of binocular microscopes, owing to a focal difference in the eyes. In a case mentioned one eye was far sighted, while the other was near sighted. For reading purposes, this person wears a pair of spectacles in which the one glass is made for the far sight, while the other is a plain glass, the left eye being near sighted, and consequently requiring no aid from spectacles with which to read. Instances are cited of persons who, while employing both eyes for ordinary vision, usually employ only one in reading. If any difference of the kind exists between the visual powers of a pair of eyes, it may be readily detected. Hold up a piece of card before one eye, so as to cut off its field of view, and then look at some object before you with the other. Then gradually bring the card before the other eye, and view the same object. If the object is seen with the same distinctness in each case, then your eyes are perfect as regards the balance of their foci; if not, then there is focal difference more or less decided. It would no doubt be advisable to take account of this very frequent difference of focus, in selecting a pair of spectacles.

IMPROVED ATOMIZER.

The ingenious little arrangement represented in our illustration is designed to distribute perfumes in the form of spray. Its simple and inexpensive construction renders it applicable to the stopper of every perfume bottle, so that the purchaser, instead of buying vaporizer and liquid separately, as heretofore, is now enabled to purchase both together at a cost very slightly increased above that of the extract singly.

There is a hollow collapsible bulb attached to the top of the hollow stopper, by stretching its mouth over a groove in the latter. Extending up from the liquid is a tube, A, the end of which is bent at right angles and terminates in a small nozzle which is surrounded by a hollow projection, B, of the stopper. It will be observed that there is an opening between the stopper and interior of the bottle at B, so that, on compressing the bulb, air is forced down upon the liquid, which is thereby caused to rise up through the tube, A. A small part of the air pressure only, however, serves this purpose, and hence the greater portion escapes through the projection, B, surrounding the fluid, escaping from the nozzle of A, with an annular jet of air which converges at a point a little beyond the two nozzles. The effect of this is to break the liquid up into spray or vapor and also to distribute it much more effectually than the similar apparatus depending upon a cross jet to draw up and expel the fluid.

The invention, which we have recently had occasion to examine, seems to us a desirable article which might form a profitable addition to the stock of druggists generally.

Patented September 23, 1873, by Mr. John N. Gerard, 139 William street, New York city.

The Phœnix Post not an European Invention.

Professor W. P. Blake, in a recent report upon the iron and steel department at the Vienna show, published in the *Tribune*, mentions as novelties a series of girders over 60 feet long, and hollow iron posts of the same length, and a foot or more in diameter, made of four flanged pieces riveted together. Mr. John Griffen writes to correct the impression given that these posts or girders are of foreign invention; as he very truly says, they are nothing more than the well known Phœnix wrought iron column, invented and patented by Mr. Samuel J. Reeves, President of the Phœnix Iron Company, in 1862. Mr. Griffen says that, during the interval since its invention, this column or post has been largely manufactured at the Phœnix Iron Works, and many thousand tuns of them have gone into the construction of wrought iron bridges, viaducts, depots, warehouses, and other structures in various parts of the United States, Canada, Nova Scotia, and in South and Central America. All the top chords and posts of the trusses in the International Bridge over the Niagara river, near Buffalo, are made of Phœnix columns. The same can be said of the Intercolonial and all the new bridges on the Grand Trunk Railway in Canada, the Augusta bridge in Maine, the Girard avenue bridge over the Schuylkill, the New River and Greenbrier bridges in Virginia, the three wrought iron bridges at Rock Island, Ill., and scores of others. Many important viaducts are composed almost entirely of these columns—as the Lyman and Rapallo viaducts in Connecticut; the Lyon Brook, Deep Gorge, and Blockhouse in New York; Bullock Run and Bank Lick in Kentucky; the Agua Venugas in Peru. Many of these structures are of great length and depth, the last mentioned being 580 feet long, and crossing a gorge 252 feet deep, over which the Lima and Arroya railroad is carried. The overhead Greenwich street rail way, in New York city, rests on a continuous line of these columns, though not by any means a good type, owing to their flaring tops and bottoms, made to suit the peculiar notions of the contractor of the railway.

To this, we may add that the proposed 1,000 feet tower, which Messrs. Clarke, Reeves & Co. have designed, and which is in progress of engraving for these columns, will form one of the most remarkable applications of the celebrated Phœnix posts.

Railroad Tunnel at Richmond.

The Chesapeake and Ohio Railroad Company have, for two years, been trying to tunnel through Church Hill, in the eastern part of Richmond, but the work has been attended with unexpected impediments. It was supposed it could be completed for $300,000, as there were no rocks, and the contract was let at that price. The tunnel runs 80 or 90 feet below the surface, through a slippery blue clay, which has the habit of caving in at the most unseasonable times in the most disagreeable manner. The contractors long ago gave up, and the railroad company was compelled to take the work. Six or seven men have been killed, while the repeated cavings have undermined many houses over the line, which is three quarters of a mile long, and is not yet open.

With one of the tunneling machines, such as were used in boring the experimental section of the Broadway Underground Railway, in this city, it would seem as if the above tunnel might have been executed in a very short time, with perfect security against caving.

IMPROVED TOOL HOLDER.

This is a useful little device, by means of which a number of different implements, such as fine saws, knife blades, awls, screwdrivers, gimlets, etc., may be carried in a single receptacle no larger than and resembling in form an ordinary penknife handle, and readily set firmly in place as desired for use.

The handle has a cover, pivoted, as shown in Fig. 1, which may be easily swung open, or, when closed, is held by a spring catch, A, in the position in Fig. 2. In both cover and box, just outside the pivot, is formed a jaw, so that, when the parts are closed together, a dovetail socket is made, which receives the correspondingly shaped ends of the tools. Fig. 3 is a transverse section of this portion, and shows the shape of the jaws. This invention was patented February 11, 1873, by Mr. Levi L Lamb, of Chelsea, Mass.

SCIENTIFIC AND PRACTICAL INFORMATION.

RESEARCHES IN SANTONINE

MM. Cannezzaro and Sestini note their investigations of santonic acid, which is much more energetic and more strongly characterized than santonine. It is obtained by the combination of one molecule of water with one molecule of santonine by the prolonged action of hot alkaline solutions. The formula is $C^{15} H^{20} O = C^{15} H^{18} O^{3} + H^{2}O$. The acid is a colorless substance unalterable by light, little soluble in water at ordinary temperature, but readily dissolved in boiling water, becoming on cooling deposited in the form of fine prismatic crystals. It is very soluble in ether and alcohol, and moderately so in chloroform and acetic acid. It melts between 353·8° and 357·4° Fah., differing from santonine, which melts at 370° Fah. The reddish violet color, which characterizes the latter substance when treated with alcohol and caustic potash, is not noted in santonic acid. It gives quite a strong acid reaction, and decomposes carbonates dissolved in tepid water with a brisk effervescence.

The same authors give the name santonates to the metallic derivatives from the acid, and consider that the term santonites should be applied to the compounds that M. Heldet has obtained by treating santonine with metallic hydrates or carbonates. Santonate of soda is made by a warm dissolution of santonic acid and carbonate of soda. The salt is deliquescent, and very soluble in water and in alcohol. The formula is $C^{15} H^{19} NaO^{4}$. The santonate of baryta is prepared by saturating a solution of santonic acid by hydrate of baryta. Santonate of silver is made by heating santonate of baryta to redness in nitrate of silver. This salt is amorphous and quite soluble in water.

THE REFINING OF COTTON SEED OIL.

Dr. Dotch communicates to the SCIENTIFIC AMERICAN the following method and proportions for refining cotton seed oil: 100 gallons of the crude oil are placed in a tank, and 3 gallons of caustic potash lye, of 45° Baumé, are gradually added and well stirred for several hours; or the same quantity of oil is treated with about 6 gallons of soda lye of 25° or 30° Baumé, and heated for an hour or more to about 200 or 240° Fah. under perpetual stirring, and left to settle. The clear yellow oil is then separated from the brown soap stock, and this dark soap sediment is placed into bags, where the remainder of the oil will drain off; and the sediment has a marketable value of 3 or 4 cents a pound for soap makers. The potash lye has to be made in iron pots, but the oil and lye may be mixed in wooden tanks.

TO REMOVE GREASE SPOTS.

In the removal of grease from clothing with benzol or turpentine, people most generally make the mistake of wetting the cloth with the turpentine and then rubbing it with a sponge or piece of cloth. In this way the fat gets dissolved, but spread over a greater space and not removed; the benzol or turpentine evaporates, and the fat covers now a greater surface than before. The only way to radically remove grease spots is to place soft blotting paper beneath and on top of the grease spot, which spot has first been thoroughly saturated with the benzol and then well pressed. The fat gets now dissolved and absorbed by the paper, and entirely removed from the clothing.

FELTING RABBITS' HAIR.

These hairs were formerly treated with a solution of mercury in nitric acid for the purpose of enhancing their felting properties. A mixture of nitric acid and treacle is proposed as a substitute.

THE DEPILATION OF HIDES WITH CHARCOAL.

Andersen discovered that pulverized charcoal applied to sheepskins produces the depilation of the hair. Charcoal, as is well known, has the property to take up large quantities of oxygen from the atmospheric air, and the oxygen in this form seems to exert a chemical influence on the fatty substance present in the neighborhood of the glands of the hair roots. An oxidation takes place in the pores of the skin, which destroys the glands and loosens the hair. Finely powdered charcoal is mixed with sufficient water to make a thin paste, and the hides immersed for 4 or 5 days and well turned over in the meantime, when the hair can be taken off at once. Hides treated with charcoal do not require further treatment, as is the case now with the lime process: and after being washed with water, they are ready for tanning. This will be a great advantage to the tanning trade, as leather treated in this way possesses more toughness, solidity, and flexibility. The other advantages of this treatment are great saving in time and labor, each hide weighs ½ to 1 pound more, and has less spots, the work is more pleasant and healthy, the splitting with the machine is more easily accomplished, and the cost price is the same as with lime, as the charcoal can be used over again. Animal or vegetable coal can be used in any quantity, having no deleterious property whatsoever; and for each hide 6 or 10 pounds, with the necessary quantity of water, are sufficient. The temperature should be 61° or 70° Fah., and can easily be maintained by introducing steam into the vats. The tanning process is facilitated, as no lime is left behind to neutralize the tannic acid.

A Handy Device for Teamsters.

In a short time, winter will have so far set in that our country roads will become well blocked with snow and mud, rendering the hauling of heavy machinery, wood, stone, or other large loads, no small burden upon ordinary teams. A great deal of labor and hard tugging may be saved if every wagon or truck is provided with 100 feet of stout rope and a single pulley. A snatch block is the best arranged with a strong hook, and the usual construction for slipping the tight of the rope under the strap to the sheave instead of waiting to reeve the line through on end. If a wagon gets stuck in heavy mud or in the snow, the driver has only to fasten his block to the tongue, reeve the rope through it, and attach one end to a tree or post and let his team pull on the other. Their work is of course just halved, or rather they bring twice as much power to bear in dragging the wagon clear. There are plenty of other applications of this simple device, which will readily suggest themselves. With a couple of skids for an inclined plane, heavy logs could be easily drawn on a sleigh by the unhitched team. Another case where it is likely to be useful is when loaded sleighs attempt to cross a wooden bridge. Although the horses draw the load very easily over the snow, they are often unable to start it over the generally denuded wooden flooring of the bridge, and hence would be materially aided by the tackle hitched on as we have described.

METALINE.

The accompanying engravings and description are designed to call the attention of our readers to a substance which is now offered as an absolute substitute for every kind of lubricant, compound or simple, now in use; which is claimed (and the assertion is based on experiments, so far as they have extended) to be practically indestructible, and which once applied to a machine is to render the apparatus for ever independent of the dash pot or oil can. We may state, at the outset, that the material appears to present this difference from oil, that, while the latter serves as a screen between the surfaces, keeping them apart and preventing interlocking, the present antifriction composition gives evidence of producing like results by filling up the microscopic cavities and leveling the minute projections of the parts in contact, producing uniform and highly polished faces. That the friction is reduced to a less percentage than one sixtieth of the weight, we are not at present, in the absence of positive proof, prepared to assert; and hence, save so far as is indicated in the general law that hard lubricants diminish the resistance most, we are unable to institute a direct comparison, in point of theoretical reduction of friction alone, between this and other anti-attrition compounds of softer nature. It may be added, however, that numerous cases are submitted by the manufacturers, in which it is shown that metaline has been practically employed with a marked advantage in instances where oil has proved inefficient; so that at least it may be said that the new substance has claimed for it, and to all appearances on substantial grounds, advantages which may render it, for a number of obvious reasons, an invention of no ordinary importance.

Fig. 1

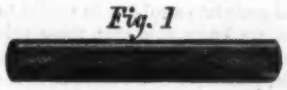


Fig. 2

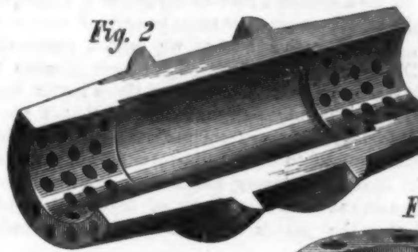


Fig. 5

Fig. 6

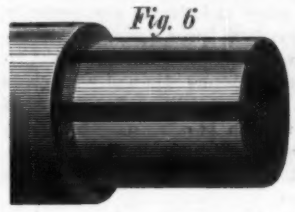


Fig. 3

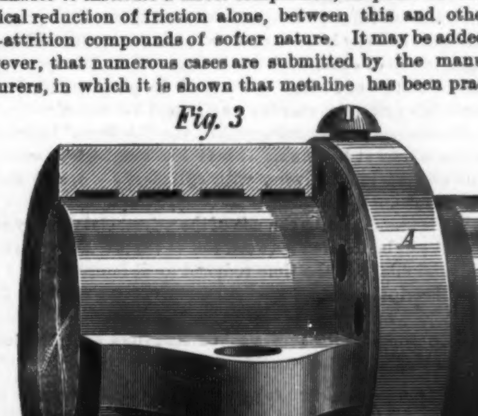


Fig. 4

Fig. 7

Metaline, for such is the name of the body under consideration, is a dark colored soft material resembling, though not necessarily containing, plumbago in certain forms. The basis is a white and brittle alloy, to which, when ground into an impalpable powder, is added the other components in quantities in direct proportion to the degree of hardness desired. The mixture completed, the substance, still in a dry powder, is placed in suitable molds, in which, under a pressure of hundreds of tuns per square inch, it is made into small cylinders, one of which is shown in Fig. 1. The remainder of our engravings represent the various modes in which the metaline is applied. The general plan, as shown in Fig. 2, is to bore into the inner periphery of the box a series of shallow cavities, into which little plugs of metaline are fitted. The two parts of the bearing are brought together, set upon end, and a reamer, forced down through the opening, pares off the projecting and irregular portions of the plugs, leaving the interior surface perfectly true and smooth.

In Fig. 3 is represented a bearing, part of which is cut away to show the manner of introducing the metaline, in section. At A, in the same figure, is a collar, which revolves with the shaft and of course rubs against the edge of the box; the manner of providing against friction by a similar arrangement of metaline disks, as already described, is here indicated, the plugs being inserted directly in the sides of the collar. Fig. 4 shows how the metaline is applied in cases where the inner periphery of the bearing is inaccessible. A collar, Fig. 5, of suitable size, is made and fitted with disks as represented, and inserted in the bearing, which is suitably enlarged to receive it. This proceeding is applicable to very small shafts, as mill spindles, etc. In certain cases where it might be preferable to avoid altering the bearing, the shaft is slotted and the metaline forced in under strong pressure, in the positions depicted in Fig. 6. Lastly, Fig. 7 represents a step for a mill spindle or any upright swiftly rotating shaft, notably of the kind used in supporting the cutter heads in woodworking machinery. Here a conical cup of brass is fitted with plugs as shown, and secured in a suitable cavity in the heavier portion. The mode of application must necessarily vary greatly with the construction of the machine, and other attending circumstances; and we may add that many varieties are made, to adapt the material to different speeds, pressures, weights, etc.

At the workshops of the company in this city, various kinds of experimental machines are now in motion, and, among others, there is a mill spindle, rotated at the rate of 8,000 revolutions per minute. The shaft is of steel, and the bearing is of similar metal, fitted as closely as can be done. Metaline is introduced in slots in the shaft. We examined the apparatus carefully and could detect no heating. Four sewing machines are also continuously running at full speed, the needle bars of some at the rate of 1,200 revolutions per minute. No oil or other lubricant but metaline is in use, and there is clearly no cutting or heating. A five horse power Baxter engine we also found running, at the rate of about 150 revolutions, without a drop of oil, and we were informed that it had been in daily use since May 1. Our attention was also called to the countershafting in the machine shop, the journals of which had been cut down to a length equal to one diameter of the shaft, as shown in our engravings, Figs. 2 and 3; and such indeed was the case with all the journals to which the metaline had been applied. We need not point out the saving of expense and material thus effected. Since January, 1870, the substance has been in use on a slotting machine, in the works of Todd & Rafferty, of Paterson, N. J. It has never been renewed, and according to the engineer, the bearing always cut with oil. The pins of the drawbridges of the Central Railroad of New Jersey, over the Passaic and Hackensack rivers, were fitted with metaline three years ago, and, as we are informed, now exhibit no signs of wear. Specimens of brasses and also of shafting shown to us, which ran for a continuous period with the lubricant, appeared to be perfectly smooth and polished like a mirror; while judging from our examination of machinery which had been in actual motion for several months, there seemed to be no working up of the substance; and so far from there being any dirt in the bearings, the revolving shafts barely soiled a white handkerchief.

Lack of space forbids our entering in greater detail into the applications of this invention. Doubtless the simple assertion that to all appearances it both obviates the use of oil and completely prevents the wearing away of rubbing parts, will at once suggest to the reader its infinitude of adaptations. It is the invention of Dr. Stuart Gwynne, and was devised some three years ago, when it was introduced in the localities above noted and in various other places in this country and in England, and was also made the subject of a commendatory report, now before us, of Chief Engineer Clark Fisher, United States Navy, to the Secretary of the Navy. By direction of the latter official, certain gunboats were to be fitted up for trial; but the burning of the company's factory, together with difficulties between interested parties, resulted in the temporary withdrawal of metaline from the market. At the present time it is again offered to the public in improved form, and is manufactured by the American Metaline Company, No. 61 Warren street, in this city. Our readers can examine the experimental machinery for themselves at the above mentioned address, or may obtain further information by letter.

COATINGS of lead oxide and salts on pottery are apt to dissolve off in acid liquids, thereby threatening the health of those who use them. Several successive coatings with a solution of sodic silicate and then exposure to a bright red heat in a furnace, prevent the trouble.

Correspondence.

Concerning a Telescope of Unlimited Power.

To the Editor of the Scientific American:

In connection with D.'s communication, on page 368 of your volume XXIX., it may be observed that the mercury, revolving in the manner described, will have a stability due to its motion, above that belonging to it while in a state of rest. The same principle applies alike to the motions of atoms and of suns, and a very striking illustration is afforded by the rigidity imparted to a stream of water issuing from an orifice under great pressure. (See Mr. Emerson's communication, page 340 of your volume XXIX).

From lack of necessary data, the writer is unable to state the exact stability of mercury due to different velocities; but after a rough estimate, it is safe to say that, if the basin of 20 feet diameter be made to revolve at the rate of 200 revolutions per minute (which speed is practicable), the mercury near the circumference of the basin will have a stability greater than lead. Now, unfortunately, the velocity at the center of the vessel will be 0, and consequently the stability at the center will be only that due to mercury in a state of rest. It is possible that we may dispense with a portion of the center of the mirror; perhaps some one will be kind enough to tell us how much, if any, may be dispensed with, without seriously impairing its efficiency.

The great amount of power required to operate the necessary machinery would preclude the possibility of using weights for imparting motion, and the next best thing that we have is an accurately balanced water wheel, imparting its motion through friction wheels. After reducing the possibility of friction to a minimum by accurate balancing, etc., we may obviate still further difficulties arising from vibrations and inequalities of motion by floating the vessel, containing the mercury destined to act as a reflector, in another vessel also containing mercury. The motion would then be imparted through the mercury in the outer vessel by friction to the mercury in the inner vessel. The consequences of this arrangement are obvious.

In regard to the plane mirrors, will some one well acquainted with the principles involved be kind enough to inform us if it is necessary that they should be quite as large as the parabolic reflector?

The oxidation of the mercury would be an item requiring attention. It might be prevented by covering the metal, while at rest, with a suitable oil, which would separate itself from the mercury while in motion. JOHN LINTON.

Baltimore, Md.

Heat and its Origin.

To the Editor of the Scientific American:

The origin of the heat developed during combustion has hitherto been a profound mystery. In the beginning of this century, it was suggested that a portion of the specific or of the latent heat of the bodies consumed was set free during the process of combustion; but this idea was soon overthrown, as it was found that the products of combustion often possess more specific heat, and almost more latent heat, than the bodies themselves did before burning, that is, before chemically combining under evolution of heat. Hence arises the question: Whence comes all this intense heat of combustion, and the subsequent great amount of latent heat, when the resultant substance in the end possesses more specific heat than its elements before combination? It is curious to remark that, in this case, the most eminent physicists concluded that combustion must be an electric phenomenon. That ignorant persons, knowing nothing of electricity, attributed the so-called spirit rappings and similar manifestations to its agency may be readily comprehended; but that scientists who have studied its laws should use this word as a pretext for explaining fire, solar heat, volcanoes, and even earthquakes, seems almost incredible. Physics form a positive science, which does not admit of vague suggestions, and a phenomenon cannot be ascribed to the work of electricity unless it is clearly shown that the well known laws and properties of electricity, when applied, explain every peculiar phase of the same. Notwithstanding that the laws of heat and electricity have been thoroughly investigated we are as yet not sure of their ultimate nature; one thing only appears certain, namely, that both are not peculiar fluids penetrating matter, but mere motions of the molecules or atoms of ponderable matter. Therefore, it is inappropriate to speak of imponderable matter, on account of the contradiction in terms, as the first property of matter is to be ponderable; we may have imponderable forces, or, better, caloric and electric forces. The so-called ether, which fills the planetary space and propagates heat and light, is probably ponderable matter; it is an atmosphere surpassing hydrogen in brightness more than hydrogen surpasses platinum, and of so small a gravitating force that millions of years will elapse before it is condensed on the planets. In fact, the spectroscope shows that, in the atmosphere of the planets and even of the sun, the materials of our earth's atmosphere are present, including water or its elements. Recent investigations of the sun and other heavenly bodies, by means of this wonderful apparatus, have besides revealed the fact that all matter may be in a more than gaseous condition, incandescent gas of so high a temperature that the elements are dissociated, that is, that all chemical affinities are destroyed, and each element exists seperately in its uncombined condition, notwithstanding that it is intermingled with others. A descent from this exceedingly high temperature to that in which the chemical affinities can manifest themselves results in the combination of the gases. The chemical affinities of the different elementary substances manifest themselves only between a comparatively limited range of temperature, below and above which they do not operate. Even as at an extreme cold no combinations can take place, so at the extreme heat, of say 8,000° Fahrenheit, not only no combustions take place, but all compounds are separated into their ultimate elements. On cooling and reaching 4,000° or 3,000° or thereabouts, the volatilized substances or gases will again combine; the chemical affinities come into play, and combustion will ensue, the heat of which will again originate partial new dissociations. This is what continually appears to take place in the sun. It has been proved that the work of dissociation is strictly analogous to that of evaporation. In imparting to a liquid, water, for instance, the property of gaseous elasticity, steam, a definite quantity of calorific energy is manifested in the newly acquired expansive power, and therefore is not displayed as temperature; in other words, heat is made latent when changing water into steam. In like manner a still larger amount of temperature is converted into the force necessary to separate the vapors into their component gases; here a greater quantity of heat is made latent, and this is that which is set free and appears in combustion when the gases combine by burning, just as latent heat is freed when gases condense into a liquid, and again when the liquid cools into a solid. In regard to the temperature of the sun, we know now that those substances most prominent on our earth exist there in a state of vapor. Iron, lime, soda, potash, etc., are there in that condition, and also steam in the dissociated state of oxygen and hydrogen. Therefore the actual temperature must be several thousands of degrees, in fact, such a heat as we cannot practically produce. Direct measurement caused Sir Isaac Newton to conclude that the sun was thousands of times hotter than melted iron, while Sir John Herschel supposed that it was a solid or liquid body, radiating from its surface only, and that its temperature ought to exceed thirteen million degrees Fahrenheit. Modern discovery has shown, however, that the sun is gaseous at least to a depth of several thousand miles, and that the gas is all incandescent, luminous, and hot.

Moreover, incandescent gases and flames are perfectly transparent for light and heat from lower strata, and therefore the solar rays not only come to us from the surface, but we receive the accumulated rays from layers of incandescent gases several thousand miles in thickness. From the effects of these gases, the surface of the sun is continually being disturbed in a manner compared to which the more violent hurricanes, thunderstorms, and volcanic eruptions on our earth sink into utter insignificance. X.

The Prismoidal Railway.

To the Editor of the Scientific American:

Observing in your journal of December 13, 1873, an article, copied from the *Public Ledger*, referring to Crew's prismoidal railway, we beg to call your attention to an error which we will thank you to have corrected. The error lay in the statement that "the track upon which the trial was made, contained 36 feet lumber and 18 pounds of iron to the lineal foot;" it should read "lineal yard." We beg further to inform you that, by consent of the President of the Atlanta and West End Street Railway Company, Atlanta, Ga., for whom the locomotive was built, Mr. E. Crew, the patentee, has been allowed its use in order to demonstrate its power and the principle of his railway on a track of 500 feet circumference, now building at the Chestnut street rink in our city, which he has rented for that purpose; where, in the course of a couple of weeks, he intends to bring it directly before the attention of railroad men and corporations. The prism of this trial railway is 24 inches wide at base, with 18 inches hight to top of cone, with an 18 lbs. rail on its apex. The curves will be of 37 feet radius, and he purposes to demonstrate his principle, starting on a trip of 500 miles.

We enclose you a photograph of the "Atlanta" locomotive which is now at the rink. It is 11 feet long, 4 feet wide, and has two 24 inch drivers, with cylinders 5 × 8, and weighs only 4 tuns.

We contend that, by the use of the prismoidal railway, rapid transit can be insured between the cities of New York and Philadelphia, and the time reduced to 1¼ hours.

Philadelphia, Pa. GEO. W. GRICE & CO.

The Relative Efficiency of Engines and Boilers.

To the Editor of the Scientific American:

The question of the relative economic efficiency of modern engines as compared with that of boilers, as they are now constructed, is being agitated among engineers in this city, and it has occurred to me that it is a subject that will interest the readers of your valuable journal. The discussion arose from a statement, made by one engineer, that, whereas the best modern steam engines have frequently developed from 75 to 85 per cent of the power actually furnished by the boiler, the boiler does not develope more than 15 per cent of the power actually contained in the carbon fuel. This was objected to, the reverse being claimed as being nearer the truth. Discussion on this subject in your valuable journal would be highly appreciated by the public, who well know that you are desirous of obtaining as much light as possible on all scientific subjects, and especially on steam, which enters so largely into all concerns of our daily life.

Boston, Mass. CONSULTING ENGINEER.

REMARKS BY THE EDITOR:—The subject here suggested is one of interest, and we invite correspondents to give their views.

THE Parisian pharmaceutists have contrived to incorporate cod liver oil with bread. Each pound of bread contains a little more than two ounces of the oil.

ALUMINA, FROM THE CLAY TO THE SAPPHIRE.

READ BEFORE THE POLYTECHNIC CLUB OF THE AMERICAN INSTITUTE, ON DECEMBER 15, 1873, BY DR. L. FEUCHTWANGER.—PART I.

Alumina is the oxide of the metal aluminum. It occurs in nature as corundum, which is an extremely hard mineral, ranking next to the diamond, its specific gravity being 4·0. It consists of 53 per cent aluminum and 47 oxygen. The precious gems sapphire and ruby are the representatives of pure alumina, the first of a blue and the other of pink or rose red color. If they possess a stellated opalescence, when viewed in the direction of the vertical axis, resembling a star, they are called star sapphires or rubies, which were known to Theophrastus and Pliny in the first century. The mineral corundum occurs in very fine crystals of the blue and red colors in many localities of the United States, such as New York furnishes at Amity, New Jersey at Newton, Pennsylvania at Unionville, and North Carolina. At Franklin, an extensive quarry of the crystals is now mined, one crystal weighing 300 tuns. Georgia gives red sapphires, of which California and Canada both furnish fine specimens. The minerals gibbsite and diaspore are hydrates of alumina; but the mineral emery, which stands near corundum in hardness and is the most useful material in the arts, containing the alumina and magnesia in about equal proportions, was originally brought from Asia Minor, but is now extensively mined at Chester, in Massachusetts. Alumina is also contained in a vast number of minerals. Clay is the result of the decomposition of aluminous minerals, and is, strictly speaking, a mixture of silex or flint, with at least one fourth of alumina, and has a peculiar earthy odor when breathed upon; and the mineral shale, which differs but little from clay, is extremely infusible and insoluble, and is also the companion of the silicated minerals: any earth which possesses sufficient ductility, when kneaded up with water, to be fashioned like paste by the hand, is called clay. These clays vary greatly in their composition, and are nothing more than mud derived from the decomposition or wearing down of rocks, as we see by the rain drop impressions, ripple marks, or mud cracks, which bear marks and evidence of exposure above the water, indicating plainly the long time which was required for the decomposition of the felspathic rocks, mostly contained in granite, and of granitic and gneissoid rocks and porphyry. In some regions where these rocks have decomposed on a large scale, the resulting clay remains in vast beds of kaolin mixed with pure quartz or silex, and sometimes with oxide of iron from some of the other minerals present, such as we find extensive beds of in the tertiary formation, as in New Jersey, Virginia, and South Carolina.

Before proceeding further to state what function the component parts of granite, which are the quartz, felspar and mica, occupy in the aluminous silicates, let me say a few words on the classification of rocks according to their origin and age, meaning the earth's crust, of which but a small portion is accessible to human observation. All rocks are divided into four great classes according to their different origin. The first are the aqueous; second, volcanic; third, the plutonic; and fourth, the metamorphic. Each of these four distinct classes has originated at many successive periods. It was formerly supposed that all granites, together with the crystaline or metamorphic strata, were first formed, and were called, therefore, primitive rocks, and that the aqueous and volcanic rocks were afterwards superimposed, and would rank, therefore, as secondary in the order of time. The aqueous rocks are also called the sedimentary or fossiliferous, and cover a larger part of the earth's surface than any others; they consist chiefly of mechanical deposits, such as pebbles, sand and mud, but are partly of chemical and some of organic origin, especially the limestones; they are called the stratified rocks, meaning strata which have been produced by the action of water. We have adopted these names of formations, such as the stratified and unstratified, fresh water and marine, aqueous and volcanic, ancient and modern, metalliferous and non-metalliferous formations.

The volcanic rocks are those which have been produced at or near the surface, whether in ancient or modern times—not by water, but by the action of fire or subterranean heat. These rocks are, for the most part, unstratified, and are devoid of fossils; they are the results of volcanic action and of craters more or less perfect; they are composed of lava, sand and ashes, similar to those of active volcanoes; and streams of lava may be traced from high summits or cones into adjoining valleys; and earthquakes have produced erosions, fissures and ravines (whereby we can detect porous lava, sand and scoriæ), dikes or perpendicular walls of volcanic rock, such as are observed in the structure of Vesuvius, Etna, and other active volcanoes. The basaltic rocks, forming the rocks of Staffa and of Giants' Causeway, are all volcanic; they have in their mineral composition much resemblance to the lavas, which are known to have flowed from the craters of volcanoes.

The plutonic rocks, which comprise mostly the granites, etc., differ much from the aqueous and volcanic; they are, in common with the next class, highly crystaline and destitute of organic remains; the plutonic comprehend all the granites and certain porphyries, which are nearly allied in some of their characters to volcanic formations. The metamorphic rocks, however, are stratified and often slaty, and are called by some the crystaline schists, in which are included gneiss, micaceous schists, hornblende schists, statuary marble, the finest kinds of roofing slate, and others. All the various kinds of granites which constitute the plutonic family are supposed to be of igneous and aqueo-igneous origin, and have been formed under great pressure at a considerable depth in the earth, or under a certain weight of incumbent ocean. Like the lava of volcanoes, they have been melted

and afterwards cooled and crystalized, but with extreme slowness and under conditions different from those bodies cooling in the open air; they differ from volcanic rocks not alone by their crystaline structure but by the absence of tufa and breccias, which are the products of eruptions on the earth's surface or beneath seas of little and inconsiderable depth.

The metamorphic or stratified crystaline rocks form the fourth and last great division of rocks, comprising the gneiss, mica schist, clay slate, chloritic schist, marble and the like, the origin of which is more doubtful than that of the other three classes. They contain no pebbles or sand or scoriæ, and no traces of organic bodies, and are often as crystaline as granite, yet divided into beds corresponding to sedimentary formations, and may be called stratified. The materials of these strata were originally deposited from water in the usual form of sediment, but were subsequently so altered by subterranean heat as to assume a new texture. It may be proved that fossiliferous strata have exchanged an earthy for a highly crystaline structure, even at some distance from their contact with granite; hard clays containing vegetable or other remains have been turned into slate, called the mica schist or hornblende schist, and every vestige of the organic bodies has been obliterated.

All the crystaline rocks are of very different ages, sometimes newer than the strata called secondary, and we must infer that some peculiarity must exist which is equally attributable to granite and gneiss, or in other words to the plutonic and altered rocks, which are distinguished from the volcanic and the unaltered sedimentary rocks; and that the granite and gneiss and the other crystaline formations are hypoaqueous, or rocks which have not assumed their fossil forms and structure at the surface, and occupy the lowest place in the order of superposition.

The composition of granite, as already stated, being quartz, mica and felspar, the two last named ingredients contain the alumina in the form of silicate of alumina in nearly equal proportions, and some contain also some alkaline ingredients; likewise mica consists of a silicate of alumina and another alkali, differing somewhat from those contained in the felspar; we have, for instance, the anorthite, a lime felspar, the labradorite, a lime and soda felspar, the oligoclase, a soda lime felspar, the albite, a soda felspar, the orthoclase, a potash felspar; while the mica group, such as the phlogopite, biotite, muscovite, lepidolite, and others contain about twenty per cent of alumina, and about thirty per cent magnesia in their compositions. Felspar, like adularia, amazonstone and labradorite, when polished, form ornamental minerals; the garnet, likewise a silicate of alumina, when cut and polished, forms a gem; so is the lapis lazuli a silicate of alumina, an ornamental stone furnishing the natural ultramarine blue colors. The turquoise, one of the genus, is of blue color, but is a phosphate instead of a silicate of alumina, while another interesting mineral, called wavellite, contains this alumina. The beryl and emerald are silicates of alumina with barilla, the latter colored with oxide of chrome; and the first, when cut and polished, has the name of aqua marina, and is a fine gem.

A vast number of minerals composed of alumina and silica are found in nature, which find much useful application in the arts and manufactures; the mineral cryolite from Greenland, which is an aluminate but not combined with silica, is a fluoride of aluminum and sodium, is exported to many parts of the world and furnishes the material for alumina compounds.

Common slate, fuller's earth, pumicestone, marl, loam, ocher, umber, and sienna are more or less clays or silicates of aluminum, the three latter being colored by oxides of iron and manganese.

The topaz, a beautiful gem, is a silicate and fluoride of alumina. The great family of zeolites, which are composed of hydrous silicates and represent a very interesting class of minerals, are all chemical compounds of alumina with silica; most of them contain also a considerable portion of water, and lime, soda and potash.

Clay, which is found in nature in very extensive deposits, and if of very fine quality and texture is called kaolin: and the other varieties, such as common pipe clay fire clay, Stourbridge, marl, or loam clay, and claystone: is of the same chemical composition as regards the silicate of alumina; some contain more iron, and some contain lime and the alkalies soda and potash; all, however, owe their existence to the decomposition of the granitic rock which, through many causes, either chemical or mechanical, or through the action of atmospheric air for many ages, has gradually become disintegrated; and as Brogniard found in France the granitic rock in such a condition, he called it "*la maladie du granite.*" The rock may gradually wear down either by variation of temperature or glacial action, or by congelation of water within the rock, gradually producing a split and expansion. In a chemical point, water itself may produce a powerful metamorphosis; as it contains carbonic acid, it would probably act upon the alkalies in the felspar of the decomposing granitic rock, while the silicate of alumina and the free silex would subsequently be separated by the action of water; the former, being so much lighter, would soon be washed away from the heavier silex, and after separation the clay is deposited. Very striking demonstrations of the decomposing granitic rocks may be seen in New York city, particularly in the upper part; there is a ledge of granitic rock extending from east to west, beginning at 31st street west to 60th street north; the Croton aqueduct in 42d street and Fifth avenue has been built from a granite quarried near 48th street and Tenth avenue; while on the east side, above 50th street, the gneiss rock caps the granite.

INSIDE A CHURCH ORGAN.

It is questionable whether any more magnificent specimen of human mechanical skill exists than the grand organ. The builder must unite, in his single person, the three capacities of artist, of scientist, and of workman: of the first, in order that he may possess the delicacy of ear to appreciate minute shades or variations of musical sound; of the second, that he may know and investigate the principles of acoustics which govern the productions of melodious vibrations, and the theories to be followed in constructing the apparatus from which the same may be elicited; and lastly of the skilled artificer, in order that he may contrive and invent devices for rendering the harmonies, latent in his assemblage of pipes, levers, and keys, responsive to the touch of the musician. It may seem almost a shattering of one's favorite mental idols to break down the divinity which, as the king of instruments, hedges around the organ: indeed, the dry details of levers, springs, and bellows, seem inappropriate and incongruous in connection with those grand tones which peal forth in the solemn chords which excite our reverential feelings as we kneel in the sanctuary; but Science is utterly destitute of sentiment. With imperturbable calmness she mercilessly resolves the daintiest melodies of Mendelssohn or Schumann, or the most majestic of choruses of Handel or Beethoven, into mere vibrations of the air, prolonged through certain intervals and in certain tubes, or leads us off from the reverie into which we fall over some exquisite harmony of the great tone masters into abstruse calculations as to the percentage of power due to the food absorbed by the organist *plus* the blower, which, converted into heat, is reconverted into motion by muscular action, which is again communicated to levers, etc., and which ultimately reappears in the shape of sound, and is again converted into motion when vibrating the auditory nerves

We recently spent a pleasant half hour inside an organ. We climbed ladders and mounted platforms, and enjoyed the novel sensation of standing in a small grove of tubes, where big pipes were the large trees, and the little ones, the under brush; and looking back it seems as if we investigated enough levers, springs, and rods to establish a moderate sized piano manufactory. We puzzled over the arrangement of pedals, couplers, and stops, and became hugely impressed with the skill which enables a single mortal of ordinary construction to play on so many things at once; and finally discovering some novel and really ingenious appliances which, the builder informed us, were not furnished to organs in general, we obtained through the kindness and courtesy of that gentleman the following interesting particulars:

Let us premise by observing that the instrument which formed the object of our visit is located in the church of the Holy Communion, corner of 20th street and Sixth avenue, and that it has just been completed by Mr. Hilborne L. Roosevelt, of No. 40 West 18th street, in this city. Mr. Roosevelt is one of the youngest of American organ builders; but if we may judge from the magnificent tone and almost perfect mechanism, coupled with devices of no mean inventive skill, which we find in his latest production, we may fairly assume that he has reached a foremost place in his arduous profession. His plan is to combine the best points of all schools, English, German, and French; and hence the brief sketch which we give of the arrangement of the organ in question may perhaps be considered as including many of the latest improvements of the manufacture.

Every one knows that if power be communicated indirectly, the necessary mechanism for turning corners, etc., necessitates a certain amount of frictional loss and resistance, greater, of course, than if the force was applied directly from the motor. Add to this the fact that the latter is weak, and, moreover, acts at a disadvantage, and an outline may be gleaned of the difficulty of actuating the multitudinous valves and levers of an organ, by compound levers connecting with key boards, say forty feet off, governed by the fingers of the organist. There is both a strong resistance to digital pressure, necessitating great exertion on the part of the performer, and also there exists an appreciable lapse of time between the touching of the key and the evolution of sound. The improvement which avoids this trouble is called the "pneumatic lever," and its effect is such that the keys are as easily manipulated, even with the full power of the instrument in action, as those of an ordinary pianoforte, while the interval of time between touch and sound, is barely $\frac{1}{4}$ second, which is of course practically inappreciable. In the church above noted, the organist's seat is on the ground floor, while the instrument is in a gallery. The levers from the inner extremities of the keys pass down under the flooring to a box directly beneath the loft. Here, arranged in framework, is a series of little bellows, one for each key of the organ; and in one end of each of which is a valve, operated by a lever leading from the key board. This is so adjusted that, on pressing down a key, compressed air enters the corresponding small bellows and inflates it. As the bellows enlarges, it pulls upon a lever that opens the valve connecting with the proper pipe. It will be noted that no pressure is needed on the key, except such as is necessary to lift the small bellows valve, which is of course a very inconsiderable amount.

This set, or rather these sets, of bellows, for there are two, one belonging to each bank of keys, must not be confounded with the main bellows which supplies the air blast. This apparatus is situated in the loft near the organ, and is operated by man power, forcing a powerful current of air, not directly to the pipes, but into another bellows which serves as a regulator, securing a constant, instead of an intermittent, blast, and thus preventing the disagreeable, wheezy, and unequal tooting sound often noticeable in old and imperfect instruments. The blast is finally driven into a reservoir, whence it emerges into the pipes in the manner presently to be described.

Each key board, and there may be several, belongs to an entirely separate organ, so two or more instruments may, by ingenious inter-adjustment, be combined in one and the same case. In the organ in question, there are two key boards proper, though the pedals, worked by the feet, may be termed a third; and there is another called the electro-melody, so that in fact, with two key boards and one set of pedals, the player performs upon four separate and distinct organs at will, any combination of that number, or all together. The pedal organ is merely an assemblage of low pitched pipes; and on its mechanism, it is unnecessary to dwell. The great organ is the lowest bank of keys, which connect, as before noted, with pneumatic levers. Just above the receptacle for the wind is the wind chest, which may be likened to a long shallow box, divided by numerous longitudinal partitions, making troughs. In these partitions are set the pipes, each longitudinal row of which is called a register. The lower ends of each set communicate with a compartment of the chest, and the apertures are closed by spring valves. Now, if there were but one set of pipes, each key would through the pneumatic lever, communicate with one of those valves, and hence would necessarily sound but a single tube; but there are, as we have already stated, many rows of pipes, and hence one key not only works one valve, but several, ranged in a transverse line directly across the wind chest. That is, while a single key may sound first a fundamental note belonging to a chord which is found in one register, it may open simultaneously valves belonging to tubes in other registers parallel thereto, so as to admit air, and thus produce notes having certain harmonic relation to the key note; so that in fact by a single pressure of the finger, if we so desire, we may produce a chord or portion thereof, instead of a single note, as on a piano. Each trough in the wind chest of course belongs to one set of pipes, and has its own valve, so that the organist, by means of handles near his key board, called "stops," may admit the blast into one or any number of the channels, and thus sound any register or registers he may desire. The total compass of each register, in the great organ portion of the instrument we are describing, is 58 pipes, and there are twelve stops, allowing a selection of any of that number of registers. But these latter all differ in quality of tone; for instance, one is a harmonic flute, another a trumpet, a third a clarion; in fact each has its own voice, due to the construction of the pipes. The pedal stops are arranged in similar manner, and number five in all, while the swell organ, which is operated by the second or higher key board, has a similar number of pipes, with a set of eight stops peculiar to itself. The swell organ must here be explained, as used for *diminuendo* or *crescendo* effects. It consists in mechanism similar to that already described, but enclosed in a tight box, the sides of which are made like Venetian blinds. By opening these shutters, more or less, the organist can allow the whole sound to emerge, or can confine it, and so deaden it in the closed case. The electro-melody organ is an entirely novel invention of Mr. Roosevelt, of which it would be hardly possible to convey a clear idea without engravings. It is, as we have stated, a separate little organ by itself, and is designed to carry the notes of a melody or air, in a tone easily heard above the accompaniment, and so prove very useful in congregational singing. It is connected to the upper half of the key boards, and with a Leclanché battery. Each key, on being pressed, establishes a current which magnetizes an electro-magnet and so opens the valve of the proper pipe. The peculiar point, however, lies in devices which prevent any but the upper or melody note being heard. Thus, if we strike the chord C E G C, the upper C alone could be heard, if we allowed that note to rise, then only the G, and thus throw out any number of tones. This invention is highly ingenious, and though really very simple, quite difficult to solve at first sight.

There are many other appliances which we may briefly notice in conclusion. Among them are four couplers, by which the pedal, great, and swell organs are connected, as may be desired, by a mere pressure of the finger of the organist on a button just above his key board. There are besides, five combination pedals, for drawing out the full power of the instrument, or full or part power of each integral portion. Then there is the usual tremolo arrangement, and various other refinements, which, though interesting to the musician, might fail to be appreciated by the general reader.

One of the most interesting applications of electro-magnetism, it may be remarked, is to the church organ, and we are aware of instances of its use to much larger extent than in the electro-melodic sub-organ noted above. In fact, one of the principal churches in this city has two complete organs, one being on each side of the chancel, and entirely distinct from the other. A single keyboard communicates directly with one, but operates the other by the electric current and magnets acting on the valves; so that if desired, the choir may be divided, half on each side, and yet both parties be enabled to sing in correct unison with the instrument. There are other points relating to organ improvements and manufacture, which space prevents our here dwelling upon, and to which we shall allude at an early date.

The Balloon Advertising Dodge Rejected.

The Commissioner of Patents has rejected an application for a patent for the broad idea of attaching advertisements to balloons, for the reason that a balloon is a common object, upon which every person has the right to stick or paint advertisements if he wishes. In order to support a patent, the applicant must have invented something. It is not invention merely to put advertisements on balloons.

BARROW IN FURNESS, LANCASHIRE, ENGLAND.

The enormous development of the iron trade, which has taken place in the last twenty years, has been as noticeable in England as in this country. In this time the whole district of Middlesbrough has come into existence as an iron field, the works in the neighborhood of Glasgow have been increased with astonishing rapidity; and on the west coast of Lancashire, a new town has lately sprung up, which, from the extent and quality of its production, is as remarkable as either of the other industrial centers.

The Cumberland iron ores, which abound in the neighborhood of Barrow, had been but little worked previously to the establishment of Mr. Bessemer's system; but they are now found to be the mineral particularly adapted for the production of Bessemer metal, or "low steel," as it is sometimes called. This fact, and the enterprise of many local manufacturers, aided by the capital of two territorial magnates, have created a town, which, in 1847, had a population of 325, which commenced its corporate existence only in 1867, and now has 30,000 inhabitants and produces 5,000 tuns of metal, chiefly steel, weekly. On the opposite page we give a birdseye view of this interesting and important town.

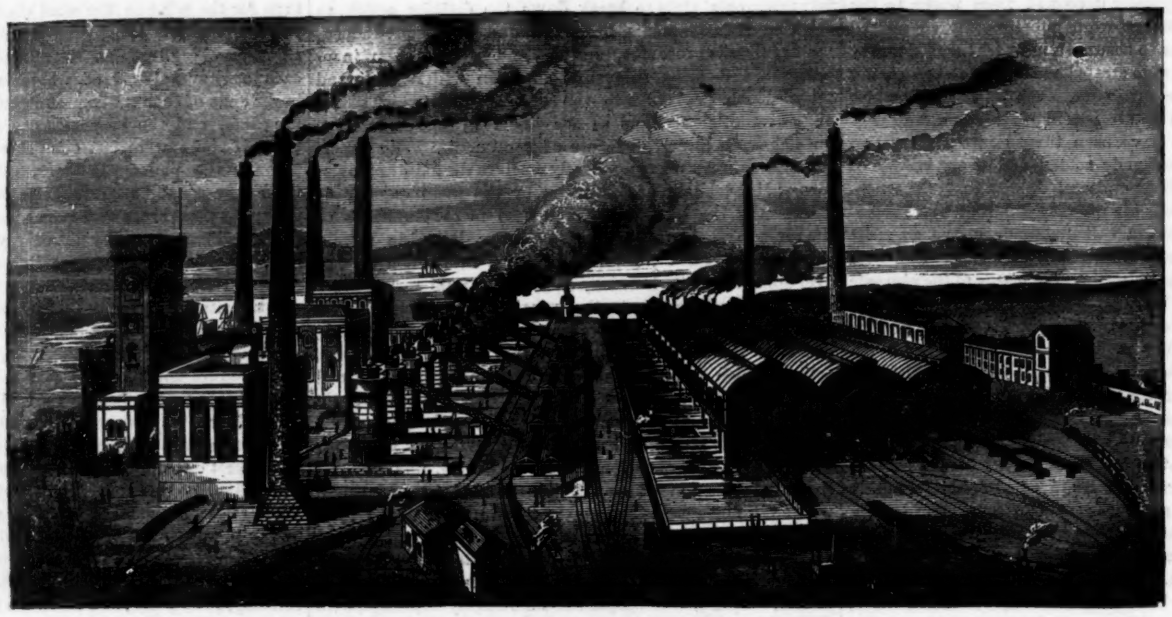


Fig. 1.—BARROW HEMATITE STEEL WORKS.

In 1864, Mr. James Ramsden, manager and secretary of the Furness Railway Company, projected and formed the Barrow Steel Company, which erected large works for the purpose of converting the produce of those furnaces into Bessemer steel, and then manufacturing the valuable material into rails, axles, tyres, and the other hundred forms in which Bessemer steel is now used. It very soon after became apparent that the two operations of smelting the ore and converting it into steel were so nearly allied in interest as well as in locality that an amalgamation was proposed between these works and those owned by Messrs. Schneider and Hannay, and was effected in 1866 under the title of The Barrow Hematite Steel Company (Limited). The Duke of Devonshire became chairman, and Mr. Ramsden managing director, and it was virtually only an offshoot of the original enterprise of the railway company. They now possess twelve blast furnaces complete, and in connection with these one of the largest Bessemer steel works in the world. These twelve furnaces stand close to the sea shore, being arranged in one straight line, but forming two groups of different sizes. The slag is tilted direct into the sea, and has already given a large increase of land on the sea side, upon which whole series of stores, workshops, and other accessory buildings, have been erected. For the present weekly production, the quantities of 10,000 tuns of ore and limestone and about 5,000 tuns of coke are needed. What would poor Dud Dudley (asks the *Practical Magazine*, from which we extract the engravings), who first introduced the use of coal for smelting purposes into England, have said to this, when, scarcely more than 200 years ago, he writes complainingly: "Some of the now going Furnaces with Charcole do make two or three Tun of Pigg or cast iron in 24 hours. . . . which quantity of cast iron, with pit cole and Sea cole at one Furnace I desire not but am contented with half the proportion!"

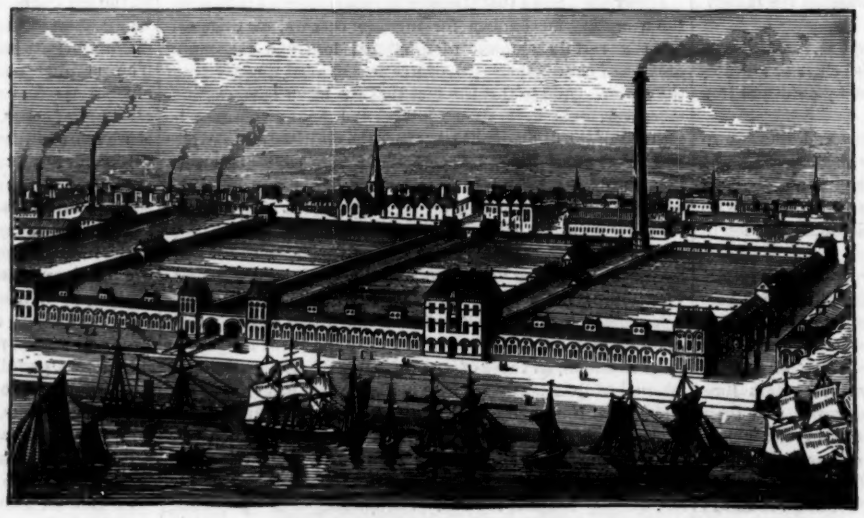


Fig. 2.—BARROW FLAX AND JUTE MILLS.

The Barrow steel works, shown in our Fig. 1, are the largest Bessemer steel works in Great Britain; and the company own several productive mines. It is believed that their profit in 1872 was not much under $3,750,000.

At the time Mr. Ramsden was first mooting the idea of the steel works, his mind was engaged also on an undertaking of but little less magnitude and utility, namely, the formation of such docks as should make Barrow altogether unrivalled as a seaport town on the large seaboard between Liverpool and the Clyde. The construction of two large docks was commenced in 1864. They were formed simply by inclosing the channel separating the town from Barrow Island by an extensive quay, forming the dock wall on the main land side. The cost of actual formation was, owing to the natural facilities of the site, only $1,000,000. All these enterprises had given an immense impetus to the growth of the town. Private enterprise has not been slow in utilizing the advantages of the new docks. There is a line of ocean steamships from Barrow to Montreal, and another between Barrow and Rotterdam. Timber is imported at the rate of one hundred cargoes annually.

The Devonshire dock is thirty acres in extent, the Buccleugh dock thirty-three, and outside of this latter there is a splendid timber pond. The entrances are sixty feet in width, and the depth of water maintained twenty-two feet. The stone quays are one and a half miles in extent; the wharves adjoining, one hundred acres, while there are at least ten miles of railway sidings. Cranes and capstans worked by hydraulic power were supplied by Sir William Armstrong, and the original warehouses, having a floor area of 17,000 square yards, have more recently been augmented by the erection of a gigantic warehouse by the side of the Devonshire dock, divided into two blocks, each block five stories in hight, and each possessing a floor area of 5,000 square yards, the two being separated by a glass-covered transit shed.

It was thought that some employment should be afforded to the numbers of women and children who congregated idly and uselessly in a town where employment had only been provided for the male members of the community. With a view of opening another branch of industry, Mr. Ramsden, towards the close of 1869, matured plans for the Barrow Flax and Jute Company (see Fig. 2), having for its object the erection of works at Barrow for the purpose of spinning and weaving flax and jute, and the manufacture of coarse cloths, sacking, bagging, wrapperings, etc. The scheme was soon successful, and at present the mills, employing some fifteen hundred hands, form one of the most conspicuous architectural ornaments of the town. Business reacts upon business, one trade upon another, and the establishment of this manufactory has now a very beneficial effect upon the commercial interests of the port. The company have for some time regularly imported their own jute direct from India, and are about to establish a regular service from Calcutta. Dundee must look to it, or it will needs have to take ashes with its sackcloth.

The year in which the jute mills were regularly opened for business also saw the establishment of another large industry, scarcely inferior to the steel works in outlay or ambition. This was the Barrow-in-Furness Iron Shipbuilding Company; and in this, as in all the other enterprises, Mr. Ramsden was the leading and directing spirit. The company secured a large tract of land on Old Barrow Island, admirably adapted for launching purposes; while on the Devonshire dock side, the site was immediately connected with the railway system. There is here accommodation for the construction of from twelve to fifteen vessels at one time. A graving dock is now in process of completion, which will afford the company the means of making repairs in a more substantial manner than was hitherto possible. These works already employ more than two thousand hands, and will, when in full movement, demand at least six or seven thousand men. The company have already contracted with the Barrow-in-Furness Ocean Steamship Company for six first-class steamers, each of which will be about 400 feet in length, of 4,000 tuns burthen, and 500 horse power. They are also building five steamships for the Ducal line of steamers trading to India, Ceylon, and the East generally, the inauguration of which line has taken place so recently and so successfully. These vessels will be about 380 feet long, 38 feet beam, and 26 feet depth of hold, 500 horse power, and 4,000 tuns burthen.

Corn mills, rolling stock factories, railway shops, newspaper offices, theatres, bath houses, a yacht club, and other indications of rapidly increasing population and public spirit, have followed. The public baths were built by Mr Ramsden at his own expense, and presented to the town.

A stroll through the works and streets of Barrow gives one as true a picture as may be of a teeming hive of modern industry. "Not 'arms and the man,' but tools and the man, is the true epic of modern times!" says Mr. Carlyle; and here we have the very nursery of tooldom. Tall chimneys all around us, with their clouds of black, dense smoke; huge furnaces pouring out by day and night their wealth of fiery molten iron; the heavy thud of the steam hammer; the sharp, ringing clangor of conflicting metals; the perpetual puffing and whistling of the locomotives, and the rattling of the railway wagons laden with hematite and coal. These, and more than these, tell us something of the power and the achievements of the Age of Iron.

A New Exploration of the Libyan Desert.

Two baggage wagons recently passed through Leipsic *en route* to Trieste, the enormous hight and unusual appearance of which attracted general attention. They were destined for the expedition which has just begun the arduous labor of exploring the great Libyan desert. Among other odd fittings, the two vehicles carried some five hundred empty iron boxes, intended for water tanks. Each vessel is enameled inside and has a capacity of about fourteen gallons, so that a supply can be transported, sufficient to render the travelers independent of the casual finding of wells or springs.

The Viceroy of Egypt, it is understood, is to defray the expense of the expedition, and this in addition to the large sums, amounting to some $500,000 yearly, which he has given for some time past to aid the labors of Sir Samuel Baker, the German traveler Schweinfurth, and the zöologist Hoekel. As to results, it is probable that our geographical knowledge of the eastern portion of the Desert of Sahara will be materially increased, and that the characteristics of an untraveled portion of the globe, as large as the whole of central Europe, will be made known.

The party left Egypt during the beginning of December, starting for Tarafieh. The objective point is Koufra, in the center of the desert, which, it is expected, will be reached by the last of January.

Preserving Brickwork.

The exclusion of damp from brickwork has long been an important problem with builders. It is stated that one of the most effective methods of accomplishing this object is the following: Three quarters of a pound of mottled soap are dissolved in one gallon of boiling water, and the hot solution spread steadily with a flat brush over the outer surface of the brickwork, care being taken that it does not lather; this is allowed to dry for twenty-four hours, when a solution, formed of a quarter of a pound of alum dissolved in two gallons of water, is applied in a similar manner over the coating of soap. The soap and alum form an insoluble varnish, which the rain is unable to penetrate, and this cause of dampness is thus said to be effectually removed. The operation should be performed in dry settled weather.

Another method is to use eight parts of linseed oil and one part of sulphur, heated together to 278°, in an iron vessel.

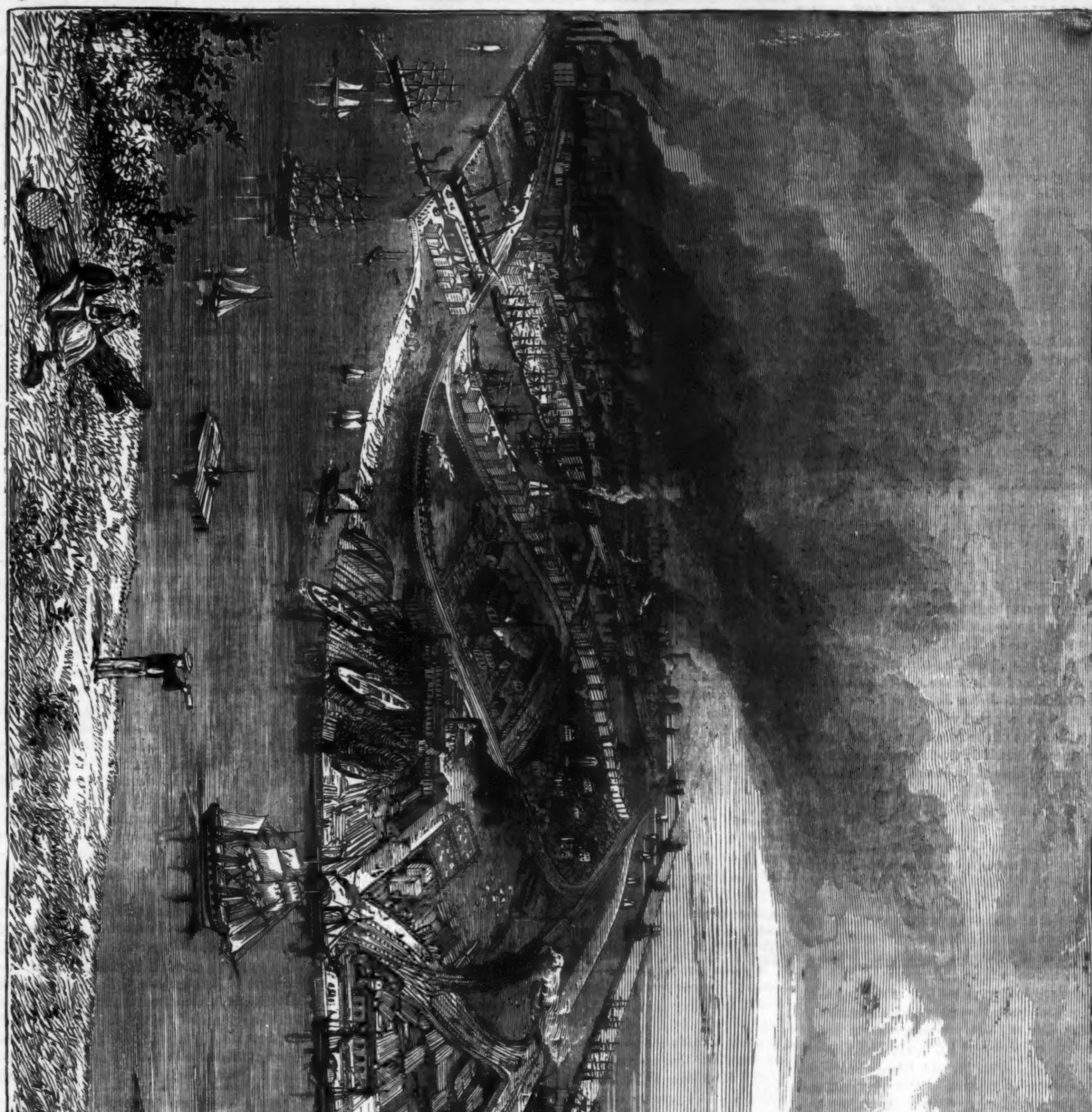


Fig. 3.—BIRD'S EYE VIEW OF BARROW-IN-FURNESS, LANCASHIRE, ENGLAND.

THE NEW EXPLORATION OF THE AMAZON RIVER, BY PROFESSOR ORTON.—OVER THE ANDES.

No. 5.

ROUTES FROM THE AMAZONS TO THE PACIFIC.

Three routes are open to the traveler from the Marañon to the Pacific: 1st. Up the Huallága to Tingo Maria, a canoe voyage of a month or more, thence to Lima by mule *vid* Huanues and Cerro de Pasco. 2d. Up the Huallága from Yurimaguas to Chasuta by canoe, eight days, thence by mule to Moyobamba *vid* Tarapóto, one week. 3d. From Yurimaguas by canoe up the Parana-pura to Balsa Puerto, one week, thence on foot through the forest to Moyobamba, six days. From Moyobamba to Cajamorca, *vid* Chachapoyas, is a mule ride of twelve days; and a railway, nearly finished, comes up from the coast within one day of Cajamorca. The time here given is that of actual travel, but the delays in procuring canoes, peons, and mules more than double it.

We chose the Balsa Puerto route. Whichever route the traveller takes, he wishes he had taken another. We left Yurimaguas in a long canoe with five Indians, providing them with salt fish, plantains, and chicha, and ourselves with more civilized food, for a six days' journey. Descending the Huallága a short distance, we turned up the Paranapura, one of its main affluents. The first day we had a comedy which might have been a tragedy. Our old "popero" or steersman fell overboard, dead drunk; another Indian tumbled out twice for the same reason, and a third dropped down into a heap in the canoe. A cold bath and a long sleep brought them to, and we had for the rest of the voyage an efficient crew.

A POLAR EXPEDITION AT THE EQUATOR.

Paddles were of no use on the rapid Parana-pura, our Indians—four in front and the comical genius behind—poling the whole distance; and every night we camped on the sandy beaches, called "plaias," under palm booths. A few pueblos break the solitude of this river. At Lemón is the spacious residence of Mons. Jules Juan, built of chonta slats and surrounded with a great variety of tropical fruit trees. Here, too, on the edge of the forest, we found another Frenchman, who amuses himself in tracing correspondences between the Quichua and Sanscrit languages. He is the author of *Amérique Equatoriale*, published in Paris, in which he styles himself "Don Enrique Vte. Ouffroy de Thoron, *Ingénieur, Emir du Liban par acclamation générale en* 1840, *Ancien Commandant ou Chef des Maronites, et Chef d'Etat, Major Generale de l'armée Turco-Maronite sous le Grand Vizier Izzet Mahomet-Pacha, Vice Roi de Syrie et d'Egypte.*"

Ascending the tributary, Cachiyácu, we passed two large distilleries, provided with the finest apparatus we have seen in the country. On the sugar mills we saw the well known names of "Mirelees, Tait & Watson, New York." We arrived at Balsa Puerta, six days from Yurimaguas. This little village of four hundred Indians, dwelling in nailless bamboo huts, that went up without the sound of a hammer, is the chief port of Mayobamba. It manufactures nothing, and the state of society is expressed in fandangos by night and in street fights by day. During our stay, ten of the chief men sat down before forty-seven bottles of porter, and soon after we saw the drunken governor, Antonio Rios, knocked down twice before his own door. With such an official to aid us in obtaining peons to carry our baggage to Moyobamba, we were detained five days. The second day out, one of the Indians dropped his load and decamped, and two others afterward followed suit.

A TRAMP THROUGH THE FOREST.

Procuring others, we continued our toilsome journey on foot, picking our way through the thick forest, climbing over precipitous mountains, and wading across the furious Cachiyacu and its tributaries seventy-five times. The road, notwithstanding the expenditure of $200,000 upon it, is nothing but a foot path, and after a rain impassable; but it is the paradise of the botanist and entomologist. The geologist also finds employment, for he crosses the lofty Cerro de Icuto, consisting of saliferous red sandstone; while the streams bring down from some unknown source fragments of fossiliferous limestone, containing ammonites, brachiopods, etc. The sandstone appears to underlie immediately the Amazonian clay formation.

Nineteen days from Yurimaguas, we reached the city of Moyobamba. The situation of this city is surprisingly fine, built on an isolated plateau that stands in the midst of a luxuriant plain, through which winds the turbid Mayo, and around which rise picturesque mountains—the worthy beginnings of the Andes. With an altitude above the sea of 2,500 feet, and a mean annual temperature of 77°, the climate is delightful. Nature is so prodigal that anybody can get a living—except physicians. The oranges of Moyobamba are equal to the best Guayaquilian; while the coffee and cacao are praised in Lima. The ordinary ills, all due to imprudence, are intermittent fever, erysipelas, and worms. The only case of drunkenness we have seen was that of a priest. We visited two mineral springs in the vicinity. One is a hot spring, slightly ferruginous, the temperature of which we found to be 106°, that of the air being 75°. On the slope of the Cerro, about three miles from the city, is a copious sulphur spring, forming a little lake thirty feet in diameter, with a temperature or 84°. Were this brought down to the city, and respectable roads made to Huallága and to the coast, Moyobamba would become the Saratoga of the south. At present, the city is poorly supplied with water, all coming from a few feeble springs at the foot of the plateau. It is a novel sight to see the long procession of women, who are the water carriers of the city, descending and ascending the deep barrancas at eventide, with pitchers on their heads, while the young Lotharios lie in wait to make love to their Rebeccas.

Transportation to and from the city is difficult beyond description. Nearly all exports and imports come from or go to the east; and everything must be carried on the backs of Indians over the horrible Balsa Puerto road and in canoes on the Parana-pura. The Indians do not care for money; so that when a traveler or merchant wishes peons, he notifies the governor, through the sub prefect, who orders the police to seize such as they can find and compel them to bear the burdens. The route to the coast *vid* Chachapoyas and Caxamarca is traveled by mules, but these are difficult to hire. There are no duties on foreign goods entering Peru by the Amazons; but the freight is enormous, the loss on liquors being two hundred per cent and on other goods twenty-five. A box of flour from the United States weighing 80 lbs. sells for twenty-two soles, or thirty cents a pound; while a roll of bread weighing three ounces costs ten cents. English butter is worth one dollar a pound; Colgate's soap, of which 6,000 lbs. are used annually, brings 50 cents a pound, and iron, of which 500 lbs. are sold yearly, sells from twenty to forty cents a pound. Beef comes from Chachapoyas, and is sold for ten cents; cattle are kept in the surrounding chacaras, but neither for beef nor milk, but for the pleasure of owning them. A few sheep are raised, but solely for meat, not for wool. Of home productions, pork is worth twenty cents; lard, thirty cents; coffee, $2 an arroba; tiles, $50 a thousand; brown sugar ("chaucaca"), five cents, refined, twenty-five. There is not a plow in the whole province; but almost everything that is planted yields beautifully in three months. August is the usual time for planting. Coffee, cacao, rice, maize, mani (peanuts), oranges, pine apples, bananas, and sugar cane are grown, but only for home consumption. Grapes (a small black kind), sarsaparilla, vanilla, rubber, and copal, grow spontaneously, but are not gathered. Abundance of fine timber (especially cedar and "moyna") covers the slopes of the cerras, with plenty of water power at hand; but there is neither a saw mill nor a chimney west of Iquitos. The Moyabambinos, 9,000 in number, are content to dwell in mud hovels, tiled or thatched. Boards are cut out with Collins' axes, 10,000 of which are sold annually; the only fault found with them (by the merchants) is that they are too good and last too long. The value of a day's work, from six to six, is twenty cents and food, or $5 a month. There are seven foreign merchants in Moyobamba, of whom Mr. Sisly, the chief, has sold as much as $40,000 worth of goods in eight months. Trade at present is very dull, as the hat business has declined.

The Department of Loreto, of which Moyobamba is the capital, stretches from the eastern cordillera to Tabatinga, and has a population of 60,000. The main villages west of the Huallága are Tarapóto (8,000), Lámas (6,000), Chasúta (1,500), and Jevéros (1,000). The main exports are straw hats, tucuyo (coarse cotton cloth), salt, aguardente, tobacco, beans, coffee, and limestone. The tucuyo is made in Tarapóto for the Indians solely; and an imitation is now manufactured in England, which sells at the same price (twenty cents) and is preferred by the natives. It takes six days to spin one pound of cotton thread, and eight days to weave one yard of tucuyo. The principal salt mines are at Callana-yacu, near Chasuta, Pillnana, and Cachi-yacu, near Balsa Puerto. They are situated in red sandstone, along with gypsum, and supply the whole Marañon region. Aguardente is made wherever the sugar cane grows. The best tobacco comes from Jevéros; and limestone boulders from up the Huallága are shipped from Yurimaguas at $40 a tun.

MOYOBAMBA AND THE MANUFACTURE OF STRAW HATS.

But the great business of Moyobamba and the surrounding villages is the manufacture of "straw" hats. These are made of the same material as the so-called Panama hats of Ecuador and New Grenada. It is the undeveloped leaf of the "bombonáje" (*carludovica palmata* of science), which is a screw pine rather than a palm. The trunk of this plant is only a yard in hight, but the leaf stalks are two yards in length. The bark of these leaf stalks is woven into baskets, and the expanded leaves are used for thatching. It is the leaf before it has opened that is prepared for the manufacture of hats. It then consists of a bundle of plaits about two feet long and one inch in diameter. The green outside of this "cogollo" or bunch is stripped off; and then by an instrument called a "picadera," resembling a pair of compasses, with legs set half an inch or less apart, according to the fineness of the straw required, the leaflets are made into strips of uniform size with parallel sides. The cogollo is then boiled to toughen the fiber, and hung up in the sun to dry and whiten, when the leaflets run up into cordlike strands, which are then ready for use. The longest straw which can be procured from the bombonáje is twenty-seven and a half inches. It takes sixteen cagollos for an ordinary hat, and twenty-four for the finest; and a single hat is plaited in from four days to as many months, according to texture. We saw a fragment of one begun which, if finished, would bring $500 in Lima. Fortunes have been made in the hat trade; but a change of fashion in Brazil, Europe, and the United States has reduced the number exported from 100,000 to 50,000, and the price from $40 a dozen to $15.

But Moyobamba is as famous for its execrable roads as for its hats. The traveller who survives the journey from Moyobamba to the Amazons or the Pacific will remember the road longer than the city. Three regions intervene between the Great River and the Great Ocean: the Montaña, extending from the Huallága to Chachapoyas; the agricultural valley of the Upper Marañon; and the mining district between the western cordillera and the coast. The lower part of the Montaña is covered with a rich forest, but from Moyobamba westward the road, or rather mule path, for the most part winds over boggy valleys, bleak paramos, and barren mountains. The distance from Moyobamba to Chachapoyas is forty leagues; for one hundred miles of which on a stretch, there is not an inhabitant, so that the traveler must carry bedding and provisions and sleep in cheerless tambos.

CROSSING THE CORDILLERAS.

The highest point on the road is the Puna Piscognañuni (meaning "the place where the birds die"), rising 11,000 feet above the sea. Geologically, it consists mainly of black slate, in which we discovered hosts of ammonites. It is this range which divides the waters of the Upper Marañon from the affluents of the Huallága, and which, meeting the more westerly sierra, forms the terrible cataracts above the Pongo de Manseriche.

Ascending and descending many a rocky staircase and winding through a deep and picturesque ravine beside the rushing Ventilla, and between towering treeless mountains of red sandstone, the weary traveller suddenly and as gratefully finds himself in the city of Chachapoyas, of which I will speak in my next. JAMES ORTON.

Improvement in Diving Apparatus.

An interesting series of experiments has been carried out in the Medway, off Chatham dockyard, by the officers and men of the Royal Engineers, under the direction of Major E. D. Malcolm, the head of the torpedo department of the School of Military Engineering for the purpose of testing the merits of an invention by Mr. Maudlin Vinter, for enabling divers, when employed at any depth, to hold conversation with those at the surface of the water. Hitherto an insuperable difficulty has been experienced by divers, in being unable to communicate verbally with the attendants above, the principle usually adopted by divers when carrying on their operations being to give preconcerted signals by so many pulls on a single line. This, however, according to *Engineering*, appears to have at length been overcome by Mr. Vinter in the invention submitted by him to the Government. In the trials just completed in Chatham Harbor, Corporal Falconer, an experienced diver of the Royal Engineers, equipped in the Siebe and Gorman improved diving apparatus (which has gained the prize medal at Vienna), made the descent; and during the whole time he was under water was enabled, by means of the new apparatus, to converse freely with those above, every word spoken by him being distinctly heard and understood. Mr. Gorman, who was present during the experimental trials, stated that the invention would be further improved upon so as to facilitate its use in all diving operations connected with harbor works, and for laying stone blocks, etc., in connection with subaqueous operations. The apparatus can, it is stated, be easily applied to any description of diving dress. The value of the invention will be readily understood and appreciated by every one interested in the science of diving, from the simple fact of the great confidence a diver will gain from being, in his isolated position, enabled to speak directly to those in whose hands his life, for the time being, is literally placed.

Tilghman's Sand Blast.

Some new and interesting applications of this invention were lately described at a meeting of the students of the Polytechnic College, Philadelphia, Pa:

Samples of raised lettering on marble, also of ground uncolored and of stained glass ornamented by the process were exhibited. Samples of thick plate glass, perforated by the sand blast with well defined holes $\frac{1}{4}$ inch in diameter, were shown. The holes for the axles of the glass plates of electrical machines can be safely cut in this way.

The lettering of the block of marble had been done by first grinding and polishing one of its surfaces, attaching the stencils (letters of the size and shape required cut out of plate metal), and then blowing sand, by means of a jet of steam, on the surface, until, where unprotected by the stencils, it is cut away to the required depth, leaving the letters in bold relief. The stone to be cut is placed upon a small struck, and then removed backward and forward upon a horizontal table, directly under the nozzle through which the sand is blown. The nozzle, which stands vertically over the table, has the pipe for the sand, entering the upper end, passing in the line of its axis, towards its lower opening. The pipe from the steam boiler enters through the side of the nozzle near its upper end, so that, when in operation, steam surrounds the tube through which the sand runs. The latter is connected by a rubber pipe, with a box of sand set about it. The machine is in operation daily at the stone yard of Messrs. Struthers & Son, who are cutting by the sand blast the sculptured design on the blocks of Cleveland stone for the walls of the grand staircase leading from the entrance hall of the new building for the Philadelphia Academy of Fine Arts, now erecting on Broad street. The design on each stone is about 20 inches by 10 inches, representing foliage, and is cut to the depth of five eighths of an inch in ten minutes. When cutting glass, the sand is compelled by a current of air from a reservoir, kept under pressure by a small blowing engine. In such a case, the stencils need not be of metal. Rubber, and even thin muslin, will protect the glass.

ELECTRICAL GAS REGULATOR.—Mr P. Munzinger, gas engineer of the Pascal Iron Works, Philadelphia, Pa., has devised a system whereby the flow of gas from the works into the mains can be regulated and controlled automatically by establishing electrical connections between any point of the gas main and the works where the gas is manufactured.

DECISIONS OF THE COURTS.

United States Circuit Court—District of Massachusetts.

BENJAMIN J. GREELEY, COMPLAINANT IN EQUITY.

In the matter of Benjamin J. Greeley, for patent for IMPROVEMENT IN SUSPENDER STRAPS.—*Decided December 14, 1873.*

In two devices—each being a combined button hole and link—where the same elements, in the same relations, enter into the same combination, and operate in the same way separately, and as a combined device, the devices are the same.

Where the opening for receiving the button in each device was longer than the diameter of the button, the fact that in one the opening was elongated in a direction at right angles with the link, and in the other in a direction parallel with the link, was held to be a mere structural change.

Structural changes of form and proportion, although they improve the operation and produce a much better result, yet one of the *same kind*, are only different and better forms of embodying the same idea, and illustrate the difference between mechanical skill and inventive genius.

SHEPLEY, J.,

This is an application for a patent for an alleged improvement in suspender straps. The application was filed in the Patent Office September 13, 1869, with two claims, which were rejected. On December 16 they were withdrawn and two others presented in lieu of them. These were rejected and withdrawn, and on the 23d of February, 1870, the present claims were presented. These claims were rejected by the Examiner February 28, and, on appeal, by the Board of Examiners April 27, and by the Commissioner on appeal from the Board, September 17, 1870, and by the Supreme Court of the District of Columbia, on appeal from the Commissioner May 3, 1871.

The bill in equity in this case is filed under the provisions of the fifty-second section of the act of July 8, 1870, and is virtually an appeal from the decree of the Supreme Court of the District of Columbia rejecting the application for the patent. *

The English patent of R. A. Brooman, granted in 1861, was cited in the references on the record. *

The device of Greeley has, first, a link for attachment to the web; second, an enlarged body of the device for the insertion of the button; third, the loop at the bottom for retaining the button. Each one of these stands in the same relation to the others and performs the same function in Greeley's as in Brooman's device. The same elements enter in the same relations into the same combination, and they operate in the same way, separately, and as a combined device. *

The Court held that the differences between the two devices are merely structural changes. Such structural changes of form and proportion, although they improve the operation without changing the mode of operation, and produce a much better result, but one of the same kind, are only different and better forms of embodying the same idea, and illustrate the difference between mechanical skill and inventive genius.

As compared with Brooman's invention, the complainant's device as a combined device is not a novel one, but possesses the same elements operating in the same way to produce the same result, and is not patentable.

Bill dismissed.

[*J. E. Maynadier*, for complainant.
Marcus S. Hopkins, for Commissioner of Patents.]

NEW BOOKS AND PUBLICATIONS.

THE WORKSHOP for December contains a continuation of the paper on the "Vienna Exhibition in Connection with Art Industry." There are a number of fine wood engravings, of original designs in silver ware, frescoing, etc., together with hints and short paragraphs useful to the decorative artist. This magazine deserves much praise for its excellent typography and the constant variety of beautiful representations of the best productions of European industrial artists which it sets before its readers. Each number contains a large sheet of working drawings, from which many of the hansomest designs may be reproduced. Published by E. Steiger, Nos. 22 and 24 Frankfort street, New York. Subscription price, $5.40 per year.

PURIFYING MIDDLINGS is a subject which is now attracting considerable attention among millers in this country. Mr. Allen, an acting assistant examiner in the Patent Office, has published a small book, giving photo engravings, and the claims of existing United States patents and a brief digest of some foreign patents. Price $25. Address all communications to DeWitt C. Allen, Room 97, Patent Office, Washington, D. C.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From November 28 to December 8, 1873, inclusive.

FINISHING FELTS.—J. F. Greene, Brooklyn, N. Y.
FLASH LIGHT SIGNAL.—Rev. J. C. Nobles, Elmira, N. Y., *et al.*
FORMING PIPE COUPLINGS.—M. Blakey, Etna, Pa.
GRINDING CYLINDERS, ETC.—J. M. Poole, Wilmington, Del.
HORSE COLLAR.—J. Heywood, Michigan.
HULLING MILL.—V. Winters, Dayton, Ohio, *et al.*
LAWN MOWER.—W. Sellers, Haverhill, Mass.
MEN'S DRAWERS.—J. J. Fitz Patrick, Philadelphia, Pa.
PRESERVING WOOD.—C. P. N. Weatherby (of New York city), London, Eng.
PRINTING PRESS.—J. T. Ashley, Brooklyn, N. Y.
PRINTING PRESS FEED.—J. T. Ashley, Brooklyn, N. Y.
ROLLING MACHINERY.—J. J. Williams, Pittsburgh, Pa.
SHIP'S ARMOR.—J. T. Parlour (of Brooklyn, N. Y.), London, England.
STITCHING BOOKS.—E. D. Averell, New York city.
STRETCHING HAT TIPS.—J. Sheldon (of N. Y. city), Edgley, Cheshire, Eng.
TUCKER.—Z. Bouillon, New Orleans, La.
WELDING IRON, ETC.—J. Popping, New York city.

Value of Patents,

AND HOW TO OBTAIN THEM.

Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables MUNN & Co. to do everything appertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN Patents.

This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model, Drawing, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them, they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure my Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office. Such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these with the fee of $5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

Rejected Cases.

Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate. Address MUNN & Co., stating particulars.

Caveats.

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Improved Extensible Brace for Supporting Trenches.

William Reilly, Newark, N. J.—This brace is designed as a substitute for the wood braces now used to stay the banks of deep cuts for sewers and the like, and it consists of a couple of strong screws screwed into a center piece from opposite directions, and having a large head, which are screwed in opposite directions against the sides of the bank so as to be adjusted, as to length, for ditches differing considerably in width.

Improved Package for Granulated Tobacco.

Goldsborough Robinson, Louisville, Ky.—This invention relates to the material which is employed to form wrappers for smoking tobacco, and consists in the application of the leaves of corn shucks for that purpose. Around the usual jacket or packet in which the cut tobacco is placed, a a series of leaves are wrapped spirally, the second binding the first and the third the second. They are folded over at the ends, provided with a tie ribbon, and then sealed at each end. The leaves of the corn shuck possess a water-repellent property and a flexibility which make them even preferable to paper, foil or cotton.

Improved Gas Cock.

Eugene M. Morris, Baltimore, Md.—This invention relates to the gas cock which conjoins the meter and service pipe of a building, and consists in novel means of insuring a perfect drip of the water which remains after the gas is shut off and which results from condensation of aqueous vapor. As soon as the valve is closed in order to shut off the gas, any liquid in the valve chamber immediately descends through a tube into the drip vessel, whence it can be drawn off at suitable intervals by the removal of the screw. By this device there is no opportunity afforded, to the matters held in solution by water, to remain in the valve chamber and make a deposit which will work in between the tube and bottom, or for the water in the bottom of the valve chamber to freeze about the tube.

Improved Plastering Machine.

Gustavus Stevens and James H. Watson, Tawas City, Mich.—This invention relates to plastering the walls of buildings, and consists in a machine so constructed and organized as to lay on and spread the mortar at one operation, thereby greatly economizing time, doing the work uniformly well, and greatly lessening the ordinary cost.

Improved Grain Cleaner.

William Houghton, Great Grimsby, England.—The grain is supplied to a first separator sieve, which retains all stones or matters larger than the grain, whence it passes on to the second separator, which removes loose dust and small seeds, both separators being mounted and operated from a crank, in the ordinary manner. The grain passing over the second separator is delivered through a chute into a spout, whence it meets an upward current of air, which, passing through it as it falls, removes any loose smut balls and other light impurities before the grain enters the scourer. The air current carries the impurities into the upper exhaust box, in which a curtain is placed, together with a damper, which may be closed, more or less, as required, to cause the heavier particles to be deposited in a box, while only the very light dust is carried on to the fan. The grain being fed to the scourer is subjected to the action of the beaters, which throw it off against the steel clothing of the cylinder, whereby the adhering smut is detached, the resulting dust being carried away by the air draft through the perforations in the cylinder to the fan by side passages. The grain gradually passes down through the scourer to the bottom, whence it escapes by the exit, which carries it into a second exhaust spout, where, as it falls, it is again subjected to a current of air, whereby the remaining impurities are separated and carried upward into a second exhaust box, in which the heavier particles, consisting principally of unsound grain, are deposited, the remainder passing on to the fan. There is a spout through which the grain is passed directly into the exit when it is desired only to separate and clean it without subjecting it to the action of the scourer, and a valve which closes the passage to the scourer and opens said spout.

Improved Machine for Riving Shingles.

Charles Shelmandine, Jefferson, N. Y.—The object of this invention is to provide a machine by which shingle, stave, and heading bolts can be rapidly and economically rived into blanks; and it consists of two or more sets of movable knives or blades, a set of stationary ones, and a movable table, and operating devices for the table and the movable knives, all combined and arranged so that a bolt put on the table under the knives will be forced against the stationary knives and split on the sides to remove the spalt; then a set of movable knives will move down and split the block into two or more pieces; and then the next set will operate in the same way, and complete the operation by successive actions, which are necessary in order that the knives will not bind in the block, as they would if the whole gang were forced through it simultaneously.

Improved Harvester Rake.

Edward Lippoldt, Brighton, Ill.—The main features of the rake, its form and manner of operation, do not differ from rakes already in use, and the invention applies exclusively to the rake arm, which is made to sweep over the apron of the machine in the usual manner. The common rake arm is ordinarily so rigid that it is very liable to be broken, and thereby occasion trouble and delay. This difficulty is remedied by making it in two parts and connecting the parts together by a hinge, a wing being attached to one part. A spring bar bears against the wing, and a bow spring rests against a projection in the hinge. When the arm is forced back by the strain upon it, it is forced against the power of the spring, and the back motion ceases when the spring becomes straightened, so that its center strikes the spring bar. When the pressure against the arm ceases, the spring bar throws it to its normal position.

Improved Safety Pocket Attachment.

Richard L. Russell, Brooklyn, N. Y., assignor to Joseph W. Robbins, who may be addressed for information concerning the purchase of rights, P. O. Box 830, New York city.—This invention consists of a little spring-actuated hook combined with thin plates of metal, having a round notch in the edge so that a watch chain, dropping into the notch when the hook is pushed back, will be confined in said notch by the hook when let go. The plates are adapted to be sewn or otherwise fastened to the pocket lid of a vest or other side pocket, so that the chain will naturally drop into the notch when the watch is put in the pocket, and thus be secured. The watch cannot then be pulled out without attracting the notice of the owner. Any other object—say, a pocket book—may be secured the same way by being attached to the chain. The device is also useful for fastening the pantaloons pocket in connection with a short chain, the latter being connected to the pantaloons, by one end, at the top of the pocket, and the end with the button being fastened in the notch of the plate by the hook, said plate and hook being fastened in or on the lid of the pocket. A little projection of the hook rises up through or above the pocket lid sufficiently to apply the thumb or finger so as to push it back readily when it is desirable to release the chain to get the watch or to open the pocket.

Improved Fire Extinguishing Water Pipe Attachment.

Thomas Miller, New York city.—This invention consists in attaching climbing pins to the standing pipe of a building so as to make it available for a fire escape. They may either be tapped directly into the pipe, or into collars, clamped on.

Improved Refrigerator.

Erastus S. Root, Providence, R. I.—This invention is an improvement in the class of domestic refrigerators in which the food chambers are arranged around a central ice or cooling chamber. The improvement consists in the construction of the cooler, to be placed within the ordinary rectangular tin lined box, and which has a central space provided with shelves and surrounded by a concentric chamber which is filled with small lumps of ice. This chamber is partly surrounded at its upper half by the other segmental concentric chambers, which are also filled with lumps of ice. The inner chamber serves mainly to keep the central space cool, besides cooling with its lower surface the outer box, while the upper segmental chambers are more especially designed to keep the box at the required temperature.

Improved Railway Switch.

William A. Slingerland, New York city.—One pair of short tracks has switch rails pivoted at one end, and frogs placed at the other; and another pair of tracks has the switch rails at one end, and the frog rails at the other; while a third pair of tracks has switch rails at one end, and inturned frog rails at the other. These three switch rails are all pivoted on the same stationary plate and a movable one in the usual manner. By placing these parts in this relation to each other, every train moving one way is compelled to take the middle rails, which always connect with the main or side track while a train moving in the opposite direction from either track will pass to frog rails or the turn-in rails; hence, under no circumstances can a train, it is claimed, be accidently thrown from the track by the carelessness of the switch tender.

Improved Adjustable Hat.

I. Ygnacio Cassiano, San Antonio, Texas.—To the hat, of any approved pattern, is applied at the inside, near its connection with the brim, a band arranged in four parts of concave shape to correspond to the shape of the head, with interstices of suitable size separating the parts. It is slotted to be produced as light as possible, and covered with the perforated leather. Each part of band is provided with one or more band springs, of brass or other material, bent in U shape, which springs are attached with their other legs in suitable manner to the body of hat. A wedge-shaped piece of cork or other material is introduced between the legs of the band spring, which wedge is pushed up or down as it is desired to make the hat larger or smaller.

Improved Corn Coverer.

Joel A. Moore, Salem, N. J.—Suitable handles guide the coverer and control the thickness of the layer of earth to be placed over the seed. A front roller serves to loosen the earth and crush the clods. The hoes are rigidly applied to a lateral piece of the frame, made of oblong shape, and placed under suitable angle toward the longitudinal axis of the coverer, by means of which the earth is thrown over the corn to cover the same, forming, also, a ridge or elevation, which is then spread out level with the hind roller. The quantity of earth to be thrown by the hoes over the seed may be regulated as the soil or circumstances require it, the roller yielding freely to the pressure exerted on the handles.

Improved Refrigerator.

Richard Armiger, Baltimore, Md.—This invention is a refrigerator so constructed that the ice water can be utilized for cooling the provision chamber. The ice chamber is formed in one part of the top of an inner box, and the bottom of which is made inclined, so that the ice water may flow off as fast as the ice melts. The ice water tank is also placed in the upper part of the inner box, but at a lower level than the ice chamber, so that the ice water may be received and held in the said tank as it drips from the said ice chamber. In the space above the ice water tank is secured a pan in which articles to be kept cool are placed, and which is made detachable, to allow the water tank to be conveniently cleaned. In the space below the ice chamber and water tank are placed shelves of perforated sheet metal or wire rods, to receive the articles to be kept cool.

Improved Milk Cooler.

Charles A. Douglas, Franklin, N. Y.—This invention consists in protecting the metal water pan of a milk cooler by a paper, felt, or other non-conducting cover or envelope for the bottom and sides, to prevent the cold water running through it for cooling the milk pan from taking up the heat of the atmosphere from the outside, the said paper or other non-conducting cover being held up to it by any suitable frame or support.

Improved Bale Tie.

Landon Carter, Huntsville, Ala.—In connection with a block and a clip or socket piece, both attached to one end of the band, and having flanges bent inward over the latter, it is proposed to employ a wedge, which is cut away or shouldered on its under side to adapt it to be inserted in the clip or socket piece, so as to bend and clamp the free end of the band.

Improved Fly Trap.

Herman L. Chapman, Marcellus, Mich.—A tin casing forms two sides and the top of the trap, and is open at the bottom. Laterally connecting tin troughs are soldered to the sides of casing and contain soapsuds, in which the flies get killed. Feet of sufficient hight to admit the flies below the trough and the sides of the trap are provided at the bottom parts of troughs. The open sides of the trough along the trap are closed by sliding glass panes, which may be easily taken out and which fit closely to the sides of the troughs so that no fly can escape. The bait is placed inside the casing, the bottom opening of which is shaded more or less by the tin casing, so that the flies, after once being in the trap, do not crawl out the same way, but fly to the light toward the glass panes, and get drowned in the troughs.

Improved Flower Maker's Grass Cutting Machine.

Theophilus Millot and James Millot, New York city.—This invention consists of a cutting board and a shifting guide for it, combined with a cutting machine of the kind commonly used for cutting paper, so that the pack of cloth pieces to be slitted and cut off in bunches, being clamped to said board, may be led along under the cutting blade, in the ordinary way, for slitting, and then shifted laterally for cutting off the bunches of grass blades. The invention also consists of a point-trimming blade, arranged on a movable support, so that it can be operated to bevel the corner of the pack of the cloth pieces while said pack is in the position for the cutting off and slitting blade to act, and which said support is so arranged that, when the slitting blade moves down, an inclined plane thereon will move the point cutter out of the way.

Improved Balanced Slide Valve.

Charles H. Hutchinson, Concord, N. H.—On top of the valve is a short cylinder. The balancing part works steam-tight against the steam chest top, and said top works up and down within the cylinder. The part working against the steam chest face excludes the steam from the top of the valve and, therefore, relieves it of so much down pressure as is due to the area on said valve from which it excludes the steam. It is held up to said face by the steam pressure on shoulders.

Improved Tilting Stand for Carboys.

Abner W. Caverly, New York city.—This invention consists of a tilting or rocking stand for tilting carboys when pouring out the contents; the object being to enable the operator to turn the carboys both down and up with a gentle and regular motion, so that the acid will not be spilled or forcibly ejected by the swashing of it by the irregular and sudden motions common to the ordinary way of handling carboys. The stand, being left to itself, will remain upright with the carboy on it.

Improved Door Latch.

Frank Stowe, Huron, O.—A recess is cut into the ordinary bolt of a door latch, which is deeper near the projecting part of the same. A dog is provided with a socket having a rubber cushion, and at its lower end with a lug, which projects under the bolt, sliding along the recess as the bolt is moved in either direction. A band spring is applied, with one end secured to the outer plate of the latch, while its other end presses firmly on the dog and lug. The socket part of the dog slides between a casing of the cover plate and the side face plate of the latch. The rubber cushion projects beyond the casing and the door, when the bolt is drawn back by the knob and the lug locks the bolt in position inside of the face plate. On closing the door, the cushion strikes noiselessly against the jamb of the door, the dog forces the spring back, releasing the lug from the wider part of the recess, causing it to slide along its narrower part, and allow, thereby, the bolt to lock into the catch plate without necessitating the forcing back of the bolt by the same. The grating noise incident to the friction of the bolt on the catch plate, as well as that caused by slamming the door, is almost entirely done away with.

Improved Game Table.

Robert R. Crawford, Wytheville, Va.—This invention is an improved game table, called the "Dexter Table," and which is between a bagatelle table and a ten pin alley, having some of the characteristics of each, and upon which various games may be played. In playing, the pins are placed upon numbered spots upon the forward end of the platforms, and a ball is placed upon the rear part of said platforms and struck with a cue, the object being to knock the pins from their places. Numbers placed at the sides of the spots from which the pins are knocked are added, and their sum is considered the number of points made.

Improved Adjustable Blackboard.

Peter W. Moeller, New York city.—This invention is a blackboard for use in schools and other places, so constructed that it may be raised and lowered to adjust it to the hight of the person using it, and according to the part of the board to be used. One part of the board, when filled, may be raised and the operation continued upon the other part. The invention consists in the combination of two blackboards and a suspension cord with a frame, grooved upon the inner surfaces of its side bars to receive the edges of the said blackboards, and in grooves of one of the side bars of the frame, made deeper in their lower parts to enable the boards to be removed and turned.

Improved Hand Cultivator.

Amos W. Ross, Northfield, Mass.—The two wheels revolve upon the journals of the axle, to which are secured the handles which are connected by a cross bar which serves to operate the machine. Guards are provided, designed to prevent the plants, when small, from being covered or injured by the soil thrown by the plows. The plows may be adjusted wider apart or closer together, or readily attached or detached as may be required. One plow is made with a projecting arm upon the upper part of one of its side edges, to smooth off the soil in forming the hills.

Improved Combined Stubble Shaver and Scraper.

Henry Von Phul, Jr., and James Mallon, Holly Wood, La.—This invention is for grubbing or shaving and scraping sugar cane stubble. The vertical side frames are rounded up to adapt them to serve as runners, and have shoes attached to them, which, at the front ends of the frames, are extended upward, and are attached to the top bars of said frames. The knives are bolted to the horizontal arms of angular bars, and have an edge formed upon both of their side edges, so that when one edge becomes dull the knives may be detached and reversed. The bars are so formed that their horizontal arms may incline to the rearward to bring the knives into a good working position. Suitable construction enables the knives to be conveniently raised and lowered, as desired; and by another arrangement the knives and a scraper are raised and lowered at the same time and by the same operation. Guards are attached to the frames to overlap the inner ends of the knives and prevent them from becoming choked with stubble or other rubbish. A cutter is also provided, the shank of which is designed to split the ridge in advance of the knives and scraper to enable them to operate more easily and with better effect.

Improved Plow.

Richard A. Brown, Oakland, Miss.—The plow has a rear land side extension, and is secured to the foot of the standard, and the latter is connected with the beam by tenon and mortise (the former having a rounded shoulder), so that it may be adjusted in a vertical plane at a greater or less pitch or angle to the beam. A forward inclined brace rod is connected with the standard, and passes through the beam. A similar rod, having nearly the same inclination as the standard, is pivoted to the land side extension, and passes through the rear end of the beam. The upper ends of the brace rods are screw-threaded, and nuts are applied thereto, so that by adjusting them the lower end of the standard, and with it the plow, can be moved forward or back to vary the pitch of the latter, and thereby govern the depth to which it will enter the soil. By this arrangement of parts the pitch of the plow is readily varied; and it is so braced by the rod that only an ordinary screw bolt is requisite to secure it to the standard, and the latter does not require to be specially strong or of peculiar form. The implement is designed for use mainly as a furrowing and barring off plow.

Improved Spoke Setting Machine.

William R. Greene, Juda, Wis.—The main frame of the machine consists of a base frame and vertical standards, which are laterally connected by a top piece. Inclined braces carry laterally a detachable shaft, on which the hubs are keyed for spoke setting and other operations, and which is connected by suitable gearing with a treadle mechanism. The spoke setting mechanism consists of two vertical recessed guide pieces, in which slides a lateral setting frame, which is carried up and down by the action of a screw bolt, and actuated by suitable gear wheels. The setting frame consists of a strong top piece, with a socket for the screw bolt, sliding pieces and bifurcated clamps, which are pivoted to the lower ends of slide pieces. The clamps carry, in connection with a pin, a sleeve of cast iron, into which the spokes are firmly placed for setting into the hub. The side flanges of the sleeve are of wedge shape, and are embraced by the prongs of clamps, which rigidly hold the sleeve in position. The upper lug-shaped end of the sleeve is introduced into a recess and adjusted there to the inclination under which the spokes are to be set into the hub. The frame slides with the sleeve down toward the hub, which is adjusted in position for it, and sets each spoke with accuracy and dispatch. On the return of the frame horizontally projecting rods force the clamps upward, so that another spoke may be inserted. The spokes are then ready to be tenoned at their outer ends, which is accomplished by a suitably arranged burr. After all the spokes are tenoned at their outer ends, the fellies are put on, and the wheel is lastly turned by the treadle mechanism, and the sides of the fellies and the edge of the same produced as nearly round as possible.

Improved Carriage Wheel.

Henry Gwynn, Baltimore, Md.—This invention relates to the construction of carriage wheels, so that they may combine the requisite strength with less weight and cost. It consists in a journal box made of wood, in sections, with wedge-shaped projections and with suitable flanges.

Improved Tool Holder.

Lewis Reder, Wilmington, Del.—This invention relates to tool holders for lathes, and consists in combining therewith a washer and shoe having corresponding inclines.

Improved Spark Arrester.

Gustaf Swenson, Hackensack, N. J., assignor to himself and Peter Bogart Jr., of same place.—This invention relates to the arrangement of devices within the hood of the smoke stack, for directing the course of the air and products of combustion entering and passing through the same. Tapering pipes are attached, larger ends upward, to the opposite sides of the upper part of the stack, and are extended downward as close to the roadway as possible. The upper ends of the pipes and stack are covered with a hood, which is made in the form of a double cone. In the forward side of the lower part of the hood are formed two holes, in which are inserted two flaring tubes. Within the hood, and in front of the upper end of the stack and guide spout, is placed a plate to form a passage leading to the upper part of the hood. By this arrangement the tubes and the plate, as the locomotive moves forward, gather the air and discharge it through the upper end of the hood, so as to increase the draft through the smoke stack, and thus counteract any tendency of the guide spout to check the draft.

Improved Revolving Sample Case.

John F. Randolph, Edwardsburg, Mich.—This invention is an improved revolving show case formed of a polygonal base with vertical partitions arranged radially around the shaft, and triangular removable trays, supported between said partitions in an inclined position by side and front strips.

Improved Process of Manufacturing Paper from Grains.

Charles V. Stehlin and Joseph Stehlin, New York city, and Heinrich A. Haan, Brooklyn, N. Y.—The object of this invention is to utilize the residue of the malt, after the process of brewing, for the purpose of producing the short fibers of the same and applying them to the manufacture of paper. The barley grains and hops, as received from the breweries, are thoroughly soaked in water to a mashy consistency and carried over a guide frame of wire gauze through rollers, which press and bruise them, and partly separate the starchy substances from the fibers. The fiberous parts are carried on over the guide frame. The starch dissolved in water passes through the wire gauze into suitable receptacles, and is carried off for condensation and extraction. The fiberous parts are submitted to a thorough mashing process, and then carried over a wire sieve, so that the watery solution of the starch may flow off. The hops are treated in a similar manner, with the exception of the rolling process, as the fibers of the hops are of such thin structure that the presure of the rollers would injure them. The fibers thus obtained are macerated in a solution of caustic lyes. A pulpy mass is gradually obtained, which, after being bleached by chlorine, may be manufactured directly, or by mixture with other fibers, into the different sorts of paper as desired.

Improved Nut Lock.

William H. Bowman, London, O.—This invention is an edge-perforated washer, connected and turning only with the bolt, and projecting laterally beyond the nut or nuts, combined with pins to lock the latter.

Improved Fastener for Meeting Rails of Sashes.

Edward Burstow, Horsham, Eng.; office in New York, 651 Broadway.—This invention relates to the ordinary sash fastener which prevents the window from being opened, and consists in a hinged plate, combined with the sash fastener to turn down over the opening between the sashes whenever they are locked. This is the most perfect sash fastener that has come before this office for some time.

Improved Car Coupling.

Thomas Andress, Auroraville, Wis.—The invention consists in the arrangement of the coupling pins with spring slides, which are disconnected from the draw bars by suitable treadle mechanism, and produce the coupling of the links by the simultaneous action of rods attached to the drawbars and coupling links on intermediate pivoted levers.

Improved Car Coupling.

Samuel Reed, Liberty, Pa.—This invention consists of a drawbar or coupling box, with side parts hinged to the rear part, and connected firmly by a hook frame, which is detached by the coupling link in case of accident, and produces the giving way of the sides and the uncoupling of the link. The coupling pin is hinged to a frame, with lever, latch, and gate, of which the latter is struck by the link, carrying the pin down for coupling. For uncoupling, the lever is raised, which detaches the link.

Improved Plow.

William T. Shipp, Charles J. Peterson, and Robason L. McLurd, Brevard Station, N. C.—This invention is a plow adapted for ready adjustment to run at different depths in the soil, by changing the angle or inclination of the standard and shoe or shovel to the beam, also of the share or shovel to the standard.

Improved Vehicle.

Martin V. Nichols, Osage, Iowa.—The wheels and frames bear against superposed springs and are placed within the sides of the carriage body. They are incased upon the inner side, no part of the wheels being in sight, except the part that projects beneath the body of the carriage. The forward end of the carriage is supported upon a single small wheel, or two small wheels placed close together, and the ends of the journal of which rest upon a frame. To the frame is attached a spindle which enters a socket attached to the front platform of the car body, and in which is placed a coiled spring. To the forward end of the frame is jointed the tongue, and to its rear end are pivoted two guide rollers, between which passes the semicircular guide rod, the ends of which are attached to the forward end of the carriage body. In the upper forward part of the carriage body is a box containing an endless strip passing over rollers. The driver can readily adjust this strip; and as suitable names are printed upon it, he can thus enable the passengers to know what street will be crossed next.

Improved Wood Sawing Machine.

John Skinner, Stockwell, Ind.—This invention consists of a saw frame of a power sawing machine, suspended by a couple of swing bars, one of which is connected to an arm which is capable of rising and falling, and is provided with a lever by which the saw is lifted up and let down, as required, in the progress of the work. The lever is arranged to be manipulated by the operator while in the position for turning the crank. The invention also consists of a saw bench for receiving the piece cut off, arranged on a pivot and connected by an arm and rod with a hand lever, so that the attendant can throw off the piece by a quick movement of the lever while standing at the place for attending to the driving gear and the saw-adjusting lever.

Machine for Removing Snow and Ice from Roadways.

Charles G. Waterbury, New York city.—This invention consists of apparatus in a portable machine adapted to run along the roadway, so contrived that it will sprinkle the surface of the roadway with hydrocarbon substances, at the same time converting some of the said substances into vapor and burning it in a space above, and causing the flame to impinge upon the surface and burn the portion sprinkled thereon directly in contact with the snow and ice.

Improved Hominy Mill.

Jacob L. Toner, Edinburgh, Ind.—The corn is admitted to the mill through a hopper, and is immediately subjected to the action of the teeth of a rapidly revolving cylinder, whereby the hulls and hearts of the kernels are knocked off and separated from the corn. The kernels of corn are also broken more or less, and dust and meal are made from the fragments which are thrown, by centrifugal force of the revolving cylinder, through the perforations of the casing, leaving the hominy clean and free from dust.

Improved Subsoil Plow.

John R. Turner and Jacob Jacobs, Fredericktown, Mo.—This invention is a subsoil plow so constructed as to run easily and steadily through the hardest soil, and loosen it thoroughly. The standard curves forward as it projects downward, and is made thin, with its forward edge sharp, to enable it to pass readily through the ground. The base of the cutter is made with a bar extending to the rearward. Upon the under side of the bar is formed a notch or recess, into which is fitted the convex upper side of the shovel, which is securely bolted to said bar. With this construction, as the plow is drawn through the ground, the shovel loosens the soil and breaks it up, leaving it light and loose without removing it from its place.

Improved Folding Pail.

Abelliard Du Chateau and John D. Williams, Green Bay, Wis.—This invention consists of a folding pail composed of an india rubber or other suitable elastic tube for the body, a metal hoop or band at the top and bottom, a wood, rubber, or other suitable bottom, and brace rods connecting the top and bottom hoops. These rods are jointed to the hoops and jointed together, so that, when the pail is to be used, they can be extended to extend the tube, and will hold it in the extended condition. They can also be folded down so as to fold the tube into a small, flat, compact package for convenience in carrying it in a wagon for use in watering horses and the like. The brace rods are arranged on the outside of the tube, and connected to the upper hoop by the same connection by which the bail is attached, and so suspend the weight directly from the bail.

Improved Furnace for Desulphurizing Ores.

Edward C. Hegeler and Frederick W. Matthiessen, La Salle, Ill.—This invention relates to a new construction of the vertical shaft furnace for desulphurizing, calcining, and drying, in the same, ores or other substances, when in a fine or powdered state. Vertical series of inclined plates form troughs, from the bottom of the furnace to the top. When the inclined plate or trough at the bottom of the column is empty, the ore of the trough next above it flows down into it until it is filled, and this process takes place along the whole column of inclined plates or troughs to the top of the furnace, where the reservoir is placed. The removal of the ore from the bottom trough causes a simultaneous movement of the ore from each trough above to the one below, and a sliding of the ore takes place along the whole column to the top reservoir of the furnace, and from the reservoir into the uppermost trough, and this movement is arrested or made continuous, just as the bottom trough is allowed to remain full or be emptied. The inclined plates are also so constructed as to allow the passage of the ascending heated gases under and next to the column of ore, where the heat is applied most effectually in contact with the ore in the trough. Finally, the invention consists in a modification of the position of the plates with the use of conducts or pockets along the inner walls of the furnace for conveying the gases, from one horizontal passage to the other, around and over the several layers of ore.

Improved Fire Indicator and Alarm.

John Fawcett, East Boston, Mass.—This invention consists of a little cage of wire or perforated sheet metal containing a card of matches, or other easily ignitable substance, arranged under a string holding a trip lever, with which a wire is connected. The wire extends to the indicator and alarm in the office or occupied room of the building, and is attached to a wheel, which, when let free by the burning of the string in the aforesaid cage, is turned by a spring, and caused to trip the mechanism of an alarm apparatus, and at the same time present to the sight hole through the case the number of the room in which the cage is fired. Any number of the detectors can be arranged in a room, in different points, and connected with the indicator and alarm.

Improved Walk Edger.

Isaac V. Brower and Joseph C. Higgins, Millstone, N. J.—The object of this invention is to provide convenient means for edging walks in yards and lawns, cutting turf straight and square for that or other purposes; and it consists in an axle, at one end of which is an ordinary wheel which runs upon the surface of the walk. At the other end is a drum which runs upon the turf. A circular cutter, made of thin steel, is attached to the side of the drum, and a plowshare follows the cutter and reverses the sod as the latter is cut. A gage is attached to the plow beam for regulating the depth of the plow.

Business and Personal.

The Charge for Insertion under this head is $1 a Line.

Answers to Correspondents

Two slight corrections are necessary to our answer about horizontal sun dials, on page 409 of vol. 29. In line 29, T W should be T U; and in line 56, for "from" read "upon."

J. B. H. can make green ink by dissolving binacetate of copper in water, or verdigris in vinegar; or better still, dissolve freshly precipitated hydrated oxide of chromium in ammonia, and add sufficient distilled water.—G. S. T. will find that drying kilns are described in our advertising columns.—J. N. C. is informed that our index of patents contains a list of all the patents issued in each week.—G. B. can probably fasten paper to steel by painting the steel with metallic paint, letting it dry, and then using mucilage or glue.—B. D. can produce a crystallized appearance on tin plate by applying to it in a heated state some dilute *aqua regia* for a few seconds, then washing it with water, drying, and coating with lacquer.—C. E. W. proposes an impossibility.—D. C. does not send data sufficient to explain his meaning.

J. P. asks: Will your directions, on page 283, vol. 29, for making plastic rubber, do for sheet vulcanized rubber, and will it be flexible after it is finished? A. The vulcanized cannot be dissolved as easily as the pure rubber.

E. J. M. asks: What is the proper solder and flux for soldering Britannia metal? A. 100 parts, by weight, of tin 1 one thousand six hundredth of copper, and 1 one thousand six hundredth of lead. Apply with sal ammoniac.

E. D. S. asks: Will a vessel, sinking in mid ocean, go to the bottom? If not, what is the reason? A. It depends on the weight of the vessel. Water is slightly compressible, and hence becomes heavier as the depth is increased. The vessel will continue to sink as long as its weight is greater than that of an equal bulk of water.

O. H. P. says: 1. I see that petroleum is recommended for removing scales in steam boilers? Is it any good? 2. What are the proper dimensions for a bolting reel to bolt 15 bushels per hour? A. 1. We do not recommend it. 2. We advise you to correspond with a manufacturer.

F. H. K. asks: How can I temper spiral springs of very thin steel wire? A. Heat over a charcoal fire and harden in oil.

J. T. D. asks: In re-boring a cylinder, is it best to make new heads? If not, how are the old ones best packed? Is it necessary to make a new piston? If an engine uses 60 lbs. of steam where it should take but 30, what am I to do? Shall I bush the exhaust? A. Ordinarily the old heads and piston can be used. It would probably be better to bush some of the leaks than to contract the exhaust.

C. A. B. asks: How are direct acting hydraulic elevators balanced so as to have the same power when 50 feet high as when 2 feet high? A. They are generally balanced by increasing the pressure, as by means of a pump.

C. T. H. asks: 1. Will cotton do as well as silk to wind the wires of an electro-magnet? 2. How can I prepare the impression of a medal in wax for plating with copper? I succeed with the medal itself, but not with the impression. A. 1. Cotton answers very well, but silk is considered the better. 2. The wax impression must be dusted with the finest plumbago and the wire made to connect with the plumbago surface.

G. F. A. J. asks: Is there any known chemical, or combination of chemicals, which would be effectual in counteracting the smell of wood alcohol when used for the manufacture of varnish? A. Wood alcohol is distilled from crude pyroligneous acid or wood spirit. Berzelius recommends the crude spirit to be agitated with a fatty oil to remove empyreumatic matter, and then to rectify it, first from recently burnt charcoal and next with chloride of calcium.

C. A. C. says: 1. What is coal tar naphtha? 2. What is a good recipe for starch polish? 3. What cement is used in uniting glass brackets? A. 1. Coal tar naphtha is a mixture of various volatile hydrocarbons obtained from distilling coal tar. By repeated purification and fractional distillation, benzole, the chief and most important constituent of coal tar naphtha, is obtained. 2. Put a small piece of paraffin about the size of a hickory nut into a bowlful of starch. This is said to give a polish to the starched articles. 3. Soak isinglass in water and then dissolve it in alcohol 3 ozs., add the bottoms of mastic varnish (thick but clear) 1½ ozs.; mix well. Set the phial in boiling water when the cement is to be used.

R. S. B. says: If the moon looks larger when near the horizon because of the peculiar condition of the atmosphere, the angular size would be greater near the horizon; but with an accurate instrument, if any difference were found, it would be that the moon is larger when near the zenith. The cause, instead of being in the atmosphere, is in the eye, being an unconscious greater allowance for distance in one case than in the other. A. The moon at the zenith is 4,000 miles nearer to the earth than at horizon, one sixtieth of the whole distance.

C. M. B. asks: 1. Would a sheet of india rubber, pure or vulcanized, ⅛ inch thick, be impervious to mercury under a pressure varying from 5 to 15 lbs. per square inch, at a temperature of 110°? Would the nature of the rubber be in any way affected by being subjected to this action for several months? 2. When mercury is kept in an iron vessel, is the nature of either metal affected by the contact? A. 1. We do not think pure rubber will be affected. 2. Not under ordinary circumstances.

A. B. H. asks: How can I dry glue in winter without having it frozen? Could you tell me the name of a work on the manufacture of glue and sand paper? A. Glue is dried on the large scale by exposing it to the air for 2 or 3 days, and, when sufficiently firm, completing the process by drying in a stove. See article on glue in Ure's "Dictionary."

W. McK. asks: Is there a premium offered by any railroad company for the invention of a railway gate to close fields, etc., through which they pass? A. No.

C. M. says: We use water from the water works, in a mill which has 180 feet or more fall from the reservoir, and we have a great deal of trouble with the pipes bursting from so great a pressure. Will the pressure be as great on the pipes if the gate or valve half way between the mill and reservoir is partly closed, supposing we are not drawing water below the gate? A. We think the pressure will be just the same, in this case. Your best plan will be to use a stronger pipe.

G. E. asks: Why do veneers, which seem firm and solid when first put on, peel off when they have lain a few weeks? The stock and veneer is perfectly dry, the glue is properly soaked and cooked; we think something is put into the glue stock, to cleanse it when the glue is manufactured, which destroys the life of the glue, or else the glue is adulterated to make it heavy. It has every appearance of being good glue. A. If the veneer and stock are as described, we know of no reason why glue properly prepared and applied should not adhere, unless it is of poor quality or has been adulterated. There is a prejudice among some workmen in favor of a dark colored glue, with somewhat of a strong odor. These properties, however, are indicative of impurity and bad preparation. The best glue is pale colored, hard and solid, and has a brilliant fracture. It should merely soften in cold water, not dissolve, and the more it swells without dissolving the better generally it is. For use, it should be broken into small pieces, allowed to soak for some hours in cold water, and then put into a boiling water bath, but never boiled itself. It is often injured by the use of too much lime in its preparation, and too long boiling, and can be adulterated with lime and phosphate of lime.

M. W. H. asks: Would any given load require more pounds pressure to push it 60 miles per hour than it would 30 miles, provided there were no resistance from the atmosphere? 2. How many pounds pressure (*minus* resistance of the atmosphere) will it require to propel a light car, weighing a tun, on a smooth level track? 3. If steam be confined, what will be its pressure at 300°, at 400° and at 500° Fah.? 4. What speed should the rim of a 6 inch circular saw (driven by foot power) run, to saw the fastest? 5. The fast motion of my foot lathe will not saw as fast as the slow motion; why is this? A. 1. Yes, under the circumstances stated. 2. About 8 lbs. 3. You will find rules, by which you can answer this question, on page 81, volume 29. 4. 9,000 feet per minute is the speed generally recommended for the rims of circular saws of all sizes. This would give about 6,000 revolutions per minute as the speed for your saw. 5. We cannot tell, from your meager statement, why you do not get good results by increasing the speed.

P. T. R. asks: 1. May any one make copies in white metal of United States and continental copper coins, and of all kinds of ancient coins and medals, and be on the safe side of the law? 2. What is the best method of making copies of coins and medals in soft metal? 3. May any one make copies of any kind of medals that do not show on their face that they are copyrighted? A. 1. We do not think there is any law against making such copies. Much expense is required to enable one to make fine castings of coins and medals. 2. A fusible alloy, which melts at a low temperature, is used. This can be made by melting together 8 ozs. bismuth, 3 ozs. tin, 5 ozs. lead. To obtain a sharp casting, the alloy should first be poured into a box, of the size of the coin, and the latter is to be pressed upon it just before it solidifies. 3. Unless the fact that an article is copyrighted is marked thereon, the owner has no claim against an infringer.

R. H. W. A. asks: 1. How can I cement glass to metal? 2. How can I dissolve enamel, used in enameling jewelry, so that when applied it will harden? 3. How can I remove tin solder from gold or silver? 4. How can I amalgamate the zinc plates in a Smee's voltaic battery? A. 1. Mix together equal weights of white lead and red lead, for the cement required. 2. Metals are enameled by covering them with vitrifiable compounds, that is, such as form a glass by exposure to heat. You cannot dissolve this enamel or apply it in any other way. 3. You can melt it, and scrape it off without injury to the other metals. 4. Wet them with dilute sulphuric acid, and at the same time rub mercury over them till a bright coating is produced.

C. says: I am running an engine, of which the governor does not work well. There is no place to oil the valve, and it sticks. I say that it would help it to put a lubricator in the pipe to oil the valve. Another man says that it will do no good. Which is right? A. We do not think the trouble is in the valve. It is probably caused by having the valve stem packed too tightly, or by some imperfection in the connections.

J. H. P., of Pa.—Minifie's "Mechanical Drawing," price $4.00, and Joynson's "Machine Gearing," price $2.00, are the two works you need. They may be had of Baird, Philadelphia, Pa., or of Van Nostrand, New York city.

D. E. B. says: Having read of the primeval copper tools found in the old and new world, I should like to ask: 1. Is it true that they will cut hardened steel? 2. What is the texture of the hardened part? 3. Is the tool hard all along or is it like our cold chisels, only tempered at the point, or where needed? 4. Does heat destroy the temper? 5. What are the electric and magnetic powers? A. We are not able to give you much information on this subject. It is true that the ancients made tools and instruments of bronze, which seemed to possess all the hardness of those made of steel, but the process of manufacture is purely a matter of conjecture.

A. F. asks: Is there any process by which nitrogen can be separated from the oxygen in atmospheric air, and if so what is it? Is the oxygen thus separated lighter than common air? A. Nitrogen can be separated from oxygen in the atmosphere by burning the oxygen out of the air. This is accomplished by setting fire to a small piece of phosphorus contained in a small vessel floating on the surface of water, and inverting a bell glass over it. The phosphorus will burn out or chemically combine with nearly all the oxygen contained in the jar leaving the nitrogen behind. This can be afterwards freed from impurity and dried by passing it first through water and afterwards through concentrated sulphuric acid. Nitrogen is lighter than the air, its specific gravity being 0·9713, while free oxygen is a little heavier, weighing about one tenth more than the atmosphere.

O. S. says: I am trying to heat my house with a hot air furnace; and in order to avoid the trouble and mutilation of plastered walls, incident to conveying heat by separate and distinct flues to every room, I purpose to have one large register directly over the furnace, which is in the cellar. Then three ventilating registers overhead are to warm three rooms which are right above. Can I do this successfully? A. Experiment shows that the most satisfactory results are obtained in the operation of a hot air furnace, by keeping the ascending current of air as independent of one another as possible. Heated air is sometimes conveyed from a furnace to a third story room through a pipe which also supplies a portion thereof to the first and second story rooms by means of a separate register in each of these stories; but this arrangement is seldom satisfactory. We understand the plan of our correspondent is to receive the whole volume of warm air into a first story room and then by three openings in the ceiling of this room admit the same air into three rooms in the second story. If the upper rooms are perfectly tight, very little air will pass through the openings in the ceiling; but if open and provided with open ventilators in the fire flues, a capricious supply may be obtained. The passage of sound, however, through these openings will make them very disagreeable. If ventilation is provided for the first story room, the warm air may pass out in this way and not ascend to the upper rooms; but without ventilation, all the foul air of the first story must ascend to contaminate the air in the second story. Probably the furnace illustrated on page 295 of our volume 29 is one that is planned more strictly in accordance with this view than any other. In this furnace, the cold air itself is divided into separate pipes before it enters the furnace; and the air, warmed in the pipe, is kept separate from the other currents until discharged at its destination. Our correspondent will find it best to have separate pipes to each room if possible, and these he may be able to insert in his chimney flues, and so avoid cutting away his partitions.

J. H. B. asks: How can rubber be reduced to a liquid state, so that it will always remain so? I have tried benzine and wood alcohol; the latter I find to work the best, but it will only dissolve a very little. I have tried linseed oil, setting it in the sun. I wish to dissolve the rubber without heat. A. The difficulty is that most of the solvents of caoutchouc are volatile, and those that are not, like linseed oil, require heat. We would suggest dissolving the rubber first in caoutchoucine, a liquid distilled from india rubber, and while liquid adding linseed oil, and stirring until a homogeneous fluid is obtained, as the oil is also dissolved by caoutchoucine. As the latter evaporates, add the oil, with frequent stirring until thick enough.

J. S. S. says: Please answer through your invaluable paper: 1. Where can I get a permanent magnet that will lift 8 lbs., and what will be its probable weight? 2. What force would it exert at a distance of one sixteenth of an inch from the poles? A. 1. From any good maker of physical apparatus. Horse shoe magnets of 1 lb. weight have been made to sustain more than 26 lbs. 2. You had better determine this by experiment.

J. P. C. says: I have a engine house some sixteen feet from a well. The well has a cucumber pump in it, and is 36 feet from platform to bottom. If I tap a pipe into the pump stick, either above or below the stationary tube or box, and carry the pipe into the engine house, and there attach a lift and force pump, will it work satisfactorily? A. We see no reason why the proposed plan will not work satisfactorily. We never recommend any particular make of machinery in these columns.

B. asks: How can I make alloys of metals that will melt at 315° and 325° Fah. respectively? A. The rule for making these alloys is as follows: Melting point of alloy = per cent by weight of first metal × its temperature of fusion + per cent of second metal × its temperature of fusion, + etc., if more metals are used. It is found, in practice, that this rule does not always give the melting point with accuracy, and it will probably be necessary for you to experiment a little, using the rule as a starting point.

S. A. says: A dispute has arisen between a friend and myself as regards the heat of water in a boiler when under a steam pressure. A says that water boils at 212° at the pressure of the atmosphere and the higher the pressure the higher is the boiling point of the water. B. says that the boiling point does not rise, that it is always 212° Fah. Which is right, and what is the ratio of the increase, if any? A. A is right. You will find the rate of increase given in a formula on page 81 of volume 29.

H. A. S. asks: How can I make a soft solder for cans, that can be easily cut with a knife? A. The usual plan, when it is desired to fasten on a cover that can be easily removed, is to use very thin plate for the cover, and fasten it with a small amount of common soft solder.

J. G. says: I am running a 8 x 12 inches engine at 100 revolutions per minute. Steam varies from 35 to 70 lbs. on the gage. The boiler is an upright, 42 inches diameter and 7 feet high, with 36 three inch flues. In the month of September I burned 190 bushels of soft Illinois coal in 26 days of 10 hours each (80 lbs. to the bushel). How many lbs. of coal per horse power per hour am I burning? Is the engine doing good duty? It is a plain slide valve engine with lap cutting off at about ⅝ of the stroke. Answer: From the data sent, we are unable to make the calculation you desire, as we have no way of determining the mean and back pressure. Send us a sketch of your valve and ports, with note of dimensions. If the point of cut-off is as stated, you must have a very large exhaust port, or a distorted action.

M. asks: Given a rotary air pump of ordinary construction, by what simple rule can I calculate how to increase or diminish the size, keeping the different proportions correct? A. We do not think there is any safe rule by which you can calculate the details of a pump of larger or smaller size, from another of given dimensions and different size.

E. A. says: Sheet iron pans are used for the evaporation of sap; a pan 8 feet long x 3 feet wide would give 24 feet heating surface. How much would it add to its evaporation to put in 14 three inch flues and let the fire pass through them and over the 24 feet heating surface? Would it make any difference how close together the flues were? Would smaller or larger flues be any better? A. The proposed plan would work well if it did not heat the sap too much. It will make little difference what size and number of flues you employ if you are careful to give them sufficient area to ensure a good draft.

E. S. A. says: 1. The atmosphere at the equator has a velocity of rotation less than the earth, equal to the velocity of the trade winds. Let us assume, however that it is the same. The force of gravity at the surface of the earth is 289 times greater than the centrifugal force, and decreases as the square of the distance from the center of the earth. The centrifugal force increases as the distance from the center of rotation. Is there then any reason why the atmosphere may not attain a hight (from the surface of the earth) of 6½ times the semi diameter of the earth? 2. If the atmosphere were influenced solely by the two forces above mentioned, the highest part would be over the equator, that is, the plane of the greatest diameter of the atmosphere would coincide with the plane of the celestial equator. But when we consider the influence of the attraction of the sun and moon, and the extremely mobile character of the molecules of the atmosphere, would not the plane of the greatest diameter be inclined from the plane of the equator towards the plane of the ecliptic, so as to almost coincide with it? 3. What is the average velocity of the trade winds? I do not find it stated in any of my books. 4. In what work will I find these subjects most thoroughly discussed? A. The earth when fluid, assumed its present form of equilibrium, an oblate spheroid. Therefore the atmosphere would be of uniform depth, as regards centrifugal force of the earth

continued to turn uniformly. 2. The Signal Service will decide the question of aerial tides. 3. We do not know. 4. The "Physical Geography of the Sea" is a superficial work, though interesting.

S. S. asks: How can I calculate the torsional strain, or ultimate resistance to rupture, of a wrenching or twisting force applied to rectangular bars of cast and wrought iron, the length of the lever to which the force is applied being known? A. Let S = one side in inches, s = other side in inches, L = leverage in inches.

For cast iron: Torsional strength in lbs. $= \frac{12{,}000 \times S^2 \times s^2}{\sqrt{S^2+s^2} \times L}$

For wrought iron: Torsional strength in lbs. $= \frac{15{,}000 \times S^2 \times s^2}{\sqrt{S^2+s^2} \times L}$

The constants given are average values.

E. A. S. asks: How can I make ink that will write with a "greenish" color, at first, and afterwards change to a deep black? Answer: There are various formulæ for making ink. We can recommend this on good authority: Aleppo galls (well bruised) 4 ounces, clean soft water 1 quart; macerate in a clean corked bottle ten days or two weeks, with frequent agitation. Then add gum arabic (dissolved in a wineglass full of water) 1½ ounces, lump sugar ½ ounce, mix well and afterwards further add sulphate of iron (green copperas) crushed fine, 1½ ounces; agitate occasionally for two or three days; then decant for use, but it is better to let the whole digest together two or three weeks. Product one quart, pale at first but soon turning intensely black.

J. E. A. asks: Are tables ever moved in the presence of so-called mediums, without contact with any person or mechanical device whatever? A. Statements to that effect have frequently been made, but we should require stronger evidence than has yet been presented to induce us to credit them.

A. M. S. says: A. H. on page 363, inquires how he can remedy the lack of power in a 25 feet breast wheel. The only remedy is in running it faster, not slower, using as much (and a little more) water in proportion as it runs faster than before. Let him reduce the 8 feet drum so as to give the wheel a little advantage over the present arrangement. He will not get so good a result from the water as formerly, and will consequently need to make a little allowance for that. I should say that if the 8 feet drum was reduced to 7 feet, or if the pulley driven by the 8 feet drum was lagged in proportion, he would be enabled to get speed. There might be a question of supply of water in the latter case.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined with the results stated:

J. R. E.—From our recollection of the small specimen of blue clay sent, it contained no graphite. Although graphite is sometimes contaminated with clay, it generally occurs in quartz, granite, gneiss, or carbonate of lime. Many clays take a polish from the finger nail; and when dark, as blue clay, the luster is metallic like that of plumbago, although none of the latter be present. Graphite, again, when disseminated in primitive or transition rocks, occurs in minute scales or nodules of different sizes not difficult to distinguish. Should it occur in small masses with clay, it could be separated from the clay by washing and running off the suspended clay, the plumbago sinking to the bottom of the vessel.

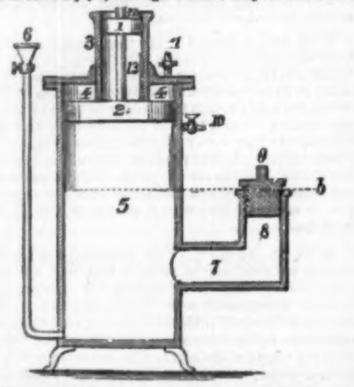
J. H. S.—The tar enclosed is a hydrocarbon of the nature of liquid bitumen, and the substance from which it has been obtained is probably (judging from the mineral enclosed) a limestone impregnated with bitumen. The mineral is limestone, containing a small quantity of iron pyrites. From the indications disclosed, and the fact that oil is found floating on the surface of ponds in the vicinity, we should judge that petroleum might be found at a sufficient depth.

J. H.—This ore is micaceous oxide of iron, so called from its being easily broken and reduced to small shining scales like mica. It is often found in connection with common specular iron, and is sometimes associated with the red oxide of iron, but is rarely in sufficient quantity to be explored by itself. It yields about 70 per cent of good iron.

W. M. L.—Selenite, a pure variety of crystalized sulphate of lime or gypsum.

A. M. B.—Carbonate of iron, or sparry iron, a compound of carbonic acid and iron.

A correspondent sends us the following problem: 1 is a piston, 6·25 square inches in area, moving airtight in cylinder 3. 2 is a piston, 12·56 square inches in area, moving airtight in cylinder 5. 3 3 is a cylinder 6·25 square inches in area and of at least 3 inches stroke. 4 4 is an annular space 1 inch deep between the head of the cylinder, 5, and the piston, 2. 5 is a cylinder 12·56 square inches in area and 12 inches long. 6 is a funnel with cock and pipe, through which 5 may be filled with



fluid by opening the cock 10 to let air out—filling first by removing plug, 9, and filling up to dotted line b, then replacing plug. 7 and 8 is a bent tube of 6·25 square inches area attached to cylinder 5. 9 is a plug to stop mouth of 8 airtight. 10 and 11 are ordinary cocks. 12 and 13 are ordinary piston rods. If 3, 4, 5, 6, 7 and 8, being full of water or mercury and all the cocks closed, pistons being in position shown in the figure, if the plug 9 is removed and weights are so placed as to overcome the friction of the piston, will they fall? If so, with what velocity, and how far? [We think our readers will have no difficulty in solving this question, as it is capable of rigid demonstration, if weights of the moving parts and the liquid are given. We shall be glad to have replies.—EDS.]

F. C. L. asks: How can I make an emery wheel?—S. H. N. asks: Is the superheating attachment placed in the Great Eastern steamer still in use?—C. A. B. asks: Is there published a book of instructions on newspaper and job printing?—S. A. T. asks: How did the old Romans calculate sums by numeral letters? For example, how did they divide MDCCCLXXII by XXIV, or multiply DCCLII by XXIV?—R. C. C. asks: How can I make colored transparent pictures for the magic lantern? I cannot make water colors transparent.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Magic Squares. By G. B. M.
On Sewage. By G. H. T.
On the Diameter of the Earth. By A. F.
On the Percentage of Work. By E. W.
On the Nickel Mines in the United States. By N.
On Coal Tar Products. By J. T. P.
On the Labor Question. By N. A. W.
On Ramming the Mold. By B. W.
On Magnets. By C. H. M.
On Solar Heat. By J. G.

Also enquiries from the following:
Q. X. P.—J. M. C.—C. L.—A. L. B.—A. B.—H. & Co.—C. C.—J. H. W.

Correspondents in different parts of the country ask: Who makes the best foot power jig saw? What is the best work on short hand writing? Who sells the best post hole augers? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal" which is specially devoted to such enquiries.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED IN THE WEEK ENDING

December 9, 1873,

AND EACH BEARING THAT DATE.

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APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed and are now pending for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

27,438.—BLACKWASHING MOLD.—W. Ferguson et al. Feb. 25.
27,447.—TIMBER BENDING CHAIN.—L. Heywood. Feb. 25.
27,473.—TURNING LATHE.—W. Sellers. Feb. 25.
27,485.—LANTERN.—A. Tufts. Feb. 25.
27,545.—FITTING SINKS.—J. Ingram. March 4.
27,594.—SEWING MACHINE.—L. W. Langdon. March 4.
27,656.—HORSESHOE NAIL MACHINE.—W. Tallman. Mar. 11.

EXTENSIONS GRANTED.

26,408.—FIRE KINDLER.—E. Bellinger.
26,410.—SEED PLANTER.—W. Blessing.
26,454.—RAILROAD SWITCHES.—W. Wharton, Jr.

DISCLAIMER.

28,244.—RUFFLE.—G. B. Arnold.

DESIGNS PATENTED.

7,018.—BUTT HINGE.—W. Gorman, New Britain, Conn.
7,019.—DOOR KNOB ROSE.—W. Gorman, New Britain, Conn.
7,020.—DOOR KNOBS.—W. Gorman, New Britain, Conn.
7,021.—ESCUTCHEON.—W. Gorman, New Britain, Conn.
7,022.—GRINDING MILL FRAME.—J. G. Lane et al., Millbrook, N. Y.
7,023.—LAMP SHADE.—W. L. Libbey, Boston, Mass.
7,024.—FLY WHEEL.—J. G. Baker, Philadelphia, Pa.
7,025 to 7,033.—CARPETS.—H. Horan, East Orange, N. J.
7,034.—CARPET.—H. Knight, Philadelphia, Pa.
7,035 to 7,037.—FLOOR OIL CLOTHS AND CARPETS.—C. T. Meyer et al., Bergen, N. J.
7,038 to 7,043.—CARPETS.—E. J. Ney, New York city.
7,044 & 7,045.—CARPETS.—H. Nordmann, New York city.
7,046.—BADGE.—J. Seymour, Syracuse, N. Y.
7,047.—SHOW CASE CORNER.—T. Vaughan, Boston, Mass.
7,048.—COOK STOVE.—N. S. Vedder, et al., Troy, N. Y.

TRADE MARKS REGISTERED.

1,565.—SOAP.—R. M. Bishop & Co., Cincinnati, Ohio.
1,566.—CURED MEATS.—W. H. Davis & Co., Cincinnati, O.
1,567.—CORSET SPRINGS.—F. L. Egbert, Waterbury, Conn.
1,568.—WHISKY.—E. A. Fargo & Co., San Francisco, Cal.
1,569.—FERTILIZER.—J. M. Rhodes & Co., Baltimore, Md.
1,570.—COTTON GIN.—Brown Gin Co., N. London, Conn.
1,571.—CARPETS.—J. Dornan, Philadelphia, Pa.
1,572.—WHISKY.—E. Howe, New York city.
1,573.—OYSTERS.—O. W. Miller & Co., Baltimore, Md.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade Mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On application for Extension of Patent	$50
On granting the Extension	$50
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

[Specially reported for the Scientific American.]

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA DECEMBER 15 TO DECEMBER 17, 1873.

2,933.—J. H. Smith, Arlington Square, Middlesex county, Eng. Improvement on shuttle sewing machines, called "Smith's Combination Sewing Machine." Dec. 15, 1873.

2,934.—Edward Gurney, Toronto, Ontario. Improvements on heating stoves, called "Gurney's Improved Base Burner." Dec. 15, 1873.

2,935.—J. L. Thurston, Douro township, Peterborough county, Ontario. Improvement on corsets, called "Thurston's Improved Elastic Corsets." Dec. 15, 1873.

2,936.—A. A. Herriman, Greensborough, Guilford county N. C., U. S. Improvements on turbine water wheels called "Herriman's Acme Turbine Water Wheel." Dec. 15, 1873.

2,937.—G. M. Stevens, Portland, Cumberland county, Me., U. S. Improvement in mitering machines, called "Stevens' Mitering Machine." Dec. 15, 1873.

2,938.—F. Jessop, York, York county, Pa., U. S. Improvement in rotary steam motors, called "Jessop's Rotary Steam Motor." Dec. 15, 1873.

2,939.—N. Phaneuf, Montreal, P. Q. *Machine a presser et a polir les talons des chaussures*, called "*Une Roue Brunissoir*." Machine for pressing and polishing heels of boots and shoes. Dec. 15, 1873.

2,940.—D. E. Rice and A. W. Mitchell, Detroit, Mich., U. S. Improvements on water gages for steam boilers, called "Rice's Boiler Gage." Dec. 15, 1873.

2,941.—M. T. Boult, Battle Creek city, Calhoun county, Mich., U. S. Improvements on wood working machines, called "Boult's Wood Working Machine." Dec. 15, 1873.

2,942.—C. W. Palmer, Cleveland, Cuyohoga county, O., U. S. Improvements on portfolios, called "Palmer's Novelty Music Rest and Portfolio." Dec. 15, 1873.

2,943.—M. Stephens, Brooklyn, Kings county, N. Y., U. S. Improvements in cement lined metal pipes, called "Stephens' Cement Lined Metal Pipes." Dec. 15, 1873.

2,944.—J. H. Thorp, Chicago, U. S. Improvements on portable burglar alarms, called "Thorp's Portable Burglar Alarm." Dec. 15, 1873.

2,945.—I. Erb, Buffalo, Erie county, N. Y., U. S. Improvement on washing machines, called "Erb's Improved Washer." Dec. 15, 1873.

2,946.—Jas. Foley, Montreal, P. Q. Extension of a provincial patent, being No. 2,614, old law, for the manufacture of the extract from hemlock, oak and other barks, for tanning purposes and as a mordant for printers' and dyers' use, called "The Non-Atmospheric Process." Dec. 17, 1873.

2,947.—O. Meijh and H. Voelter, Paris, France. Process of preparing wood or other ligneous or vegetable matter for the manufacture of paper, card board and other analogous products, called "Meijh and Voelter's Process for Preparing Wood for the Manufacture of Paper, etc." Dec. 17, 1873.

2,948.—G. Lowden, Brooklyn, Kings county, N. Y., U. S. Improvement on portable gas apparatus, called "Lowden's Portable Gas Apparatus." Dec. 17, 1873.

2,949.—C. K. Knowlton, Rockland, Me., U. S. Improvements in car couplings, called "Knowlton's Car Coupling." Dec. 17, 1873.

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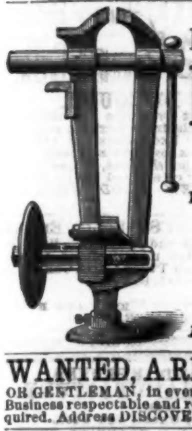

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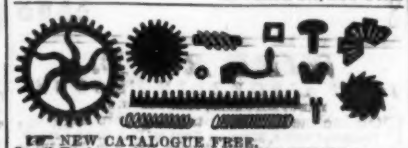

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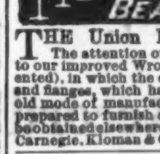

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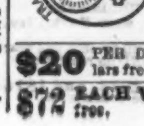

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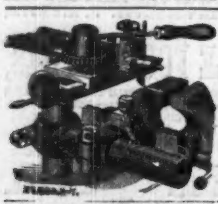

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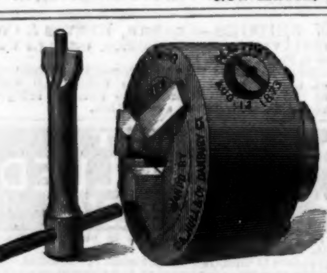

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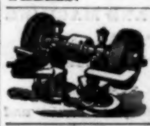

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